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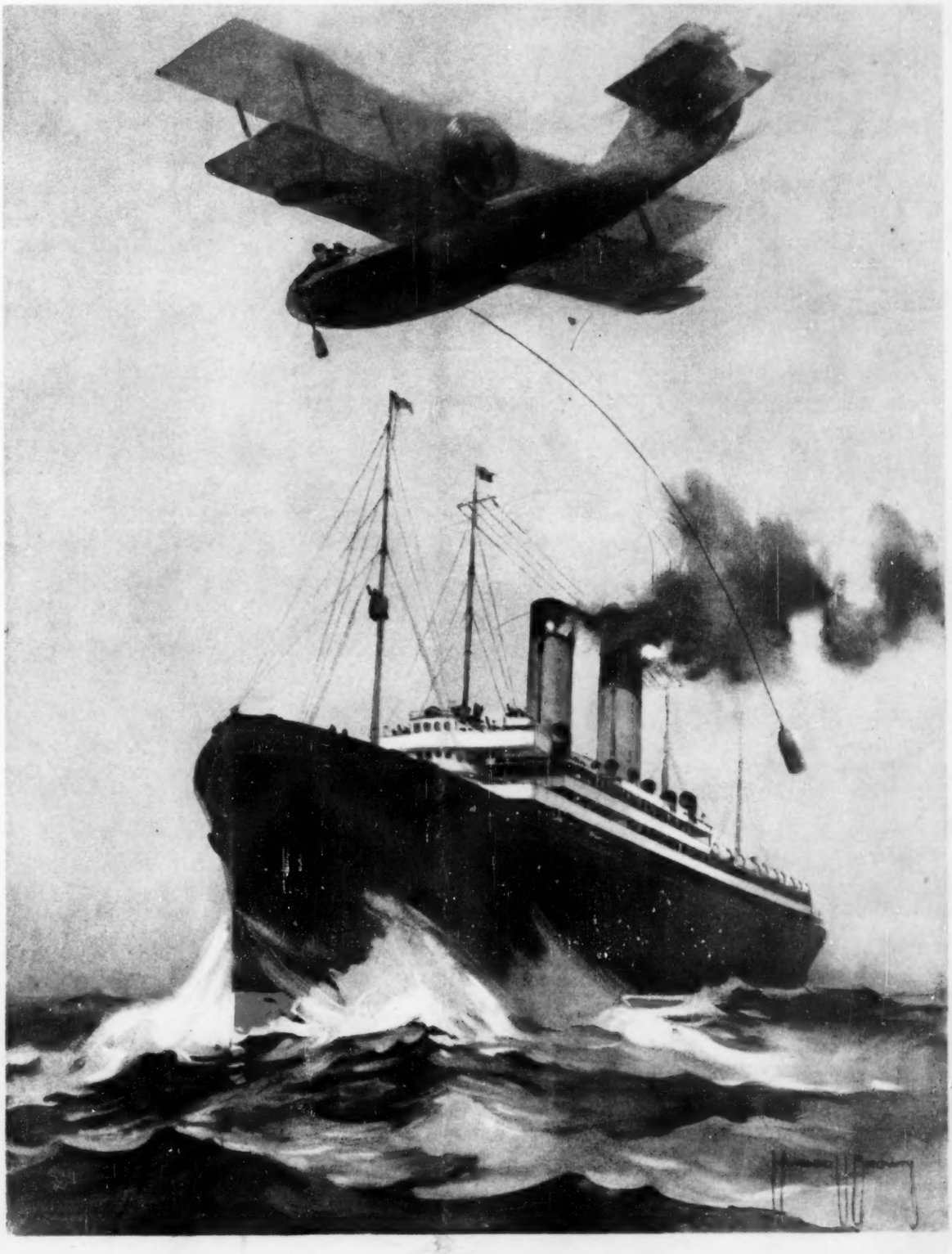

DELIVERING MAIL TO A STEAMER THREE HOURS AFTER SAILING TIME—[See page 189]

Vol. CXXI. No. 8
August 23, 1919

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Price 10 Cents
$5.00 a Year

KWONG TUNG'S ENGINES ARE RUNNING AGAIN

THE Kwong Tung Electrical Supply Company of Canton, China, installed several large Diesel engines—brought from America.

After 50 hours of running, operating trouble developed. The engines stopped. From Canton the cable flashed to the builders of the engines in America "What shall we do?"

The engine builder telephoned to the nearest Vacuum Oil Company Branch. The Branch Manager telegraphed to New York. New York cabled to the Branch office of the Vacuum Oil Company at Hong Kong.

An engineer from the Vacuum Oil Company's Branch at Hong Kong left immediately for Canton. The trouble was promptly corrected.

Kwong Tung's engines are running again.

* *

LUBRICATING engineers in Vacuum Oil Company service are repeatedly called upon to solve operating problems in all parts of the globe. Their technical knowledge has enabled them to help protect the good name of American machinery the world over.

The work must go on.

GARGOYLE

Lubricants

A grade for each type of service

Correct
AUTOMOBILE LUBRICATION

GARGOYLE

Mobiloils

A grade for each type of motor

Gargoyle Mobiloils for engine lubrication are:

Gargoyle Mobiloil "A"
Gargoyle Mobiloil "B"
Gargoyle Mobiloil "E"
Gargoyle Mobiloil Arctic

The Chart below indicates the grade recommended by the Vacuum Oil Company's Board of Engineers. The recommendations cover all models of both passenger and commercial vehicles unless otherwise noted. If your car is not listed in this partial Chart, send for booklet "Correct Lubrication" which lists the correct grades for *all* cars.

AUTOMOBILES	1913 Models		1912 Models		1911 Models		1910 Models		1909 Models	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter*	Summer	Winter
Allen	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Auburn (4 cyl.)							A	Arc	A	Arc
Auburn (6 cyl.)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Auburn (6-30)					A	Arc	A	Arc		
" (6-70B) Tarpon-H			A	Arc						
Autocar (2 cyl.)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Bowser	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (8 cyl.)							A	A		
Buick	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Cadillac (8 cyl.)	A	A	A	A	A	A	A	A	Arc	Arc
Case	Arc	Arc	Arc	Arc	A	Arc	A	Arc	A	Arc
Chalmers			A	A			A	Arc	Arc	Arc
" (6-40)							A	Arc		
" (6-50)	A	A			A	A	A	A		
Chandler Six	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Chevrolet	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (4 cyl.)	A	A	A	A	A	A				
" (F A.)	A	Arc	A	Arc			Arc	Arc	Arc	Arc
Cole	A	A	A	A	A	A	A	A	A	A
" (8 cyl.)									Arc	Arc
Cunningham	A	A	A	A	A	A	A	A	A	A
" (8 cyl.)	Arc	Arc	A	Arc	A	Arc	A	Arc	Arc	Arc
Dart					A	Arc	A	Arc	A	Arc
" (Model C)	A	A	A	A						
" (2 and 3½ ton)	A	Arc	A	Arc	A	Arc	A	Arc		
Dodge Brothers	A	Arc	A	Arc	A	Arc	A	Arc	E	E
Dort	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Federal	Arc	Arc	A	A	Arc	Arc	Arc	Arc	Arc	Arc
" (Mod. 5-X)			A	A	A	A				
Federal (special)			Arc	Arc						
Fiat			B	A	B	A	B	A	B	A
Ford	E	E	E	E	E	E	E	E	E	E
Franklin	A	A	A	A	A	A	A	A	A	A
Grant	A	Arc	A	Arc	A	Arc	A	Arc	Arc	Arc
" Com'l	Arc	Arc								
" " (Model 12)	A	Arc								
Haynes	A	A	Arc	Arc	A	Arc	A	Arc	A	Arc
(12 cyl.)	A	A	A	A	A	A	A	A		
Hudson							Arc	Arc	Arc	Arc
" Super Six	A	Arc	A	Arc	A	Arc	A	Arc		
Hupmobile	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Kelly Springfield	A	A	A	A	A	A	A	A	A	A
King									A	Arc
" (8 cyl.)	A	A	A	A	A	A	A	A	Arc	Arc
" Commercial			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Kissel Kar	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" " (Model 48)							A	A	A	A
" " (12 cyl.)			A	A	A					
Lexington	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Leyland Stewart			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (Mod. M)					A	Arc	A	Arc		
" " (Mod. MW)					A	Arc				
Locomobile	A	E	A	E	E	E	E	E	E	E
McFarlan			A	Arc	A	Arc	A	A	A	Arc
McLaughlin	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
McLaughlin (Mod. E6)	A	A	A	A						
Madison			A	Arc	A	Arc	A	Arc	A	Arc
" (8 cyl.)					A	A	A	A		
Marmon	A	A	A	A	A	A	A	A	A	Arc
Maxwell	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Mercer	A	A	A	A	A	A	A	A	A	Arc
(22-70)									Arc	Arc
Mitchell	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
(8 cyl.)							A	A		
Moline-Knight	B	A	B	A	A	A	A	A	A	A
Monroe			A	Arc	A	Arc	E	E	A	Arc
" (Mod. M4)			A	A	A	A				
" (Mod. S)	A	A								
Moon			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Nash	A	Arc	A	Arc						
" (Mod. 671)			A	A						
" (Good)	A	A	A	A						
National	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc	A	Arc
(12 cyl.)	A	A	A	A	A	A	A	A		
Nelson	A	A	A	A	A	A				
Oakland	A	A	A	A	Arc	Arc	Arc	Arc	Arc	Arc
(8 cyl.)							A	A		
Oldsmobile (4 cyl.)	A	Arc			Arc		Arc	Arc	Arc	Arc
" (6 cyl.)	A	A	A	A	Arc	Arc			Arc	Arc
" (8 cyl.)	A	A	A	A			A	A		
Overland	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Packard									A	Arc
" (12 cyl.)	A	A	A	A	A	A	A	A		
" Commercial	A	A	A	A	A	A	A	A	A	A
Paige (4 cyl.)										Arc
(6 cyl.)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (6-55)							A	Arc	A	Arc
" (6-58-30)					A	Arc				
" (6-40)	A	Arc	A	Arc						
Paige (Com'l)	Arc	Arc	Arc	Arc						
Paterson			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Peerless			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl.)	A	A	A	A	A	A	A	A		
Pierce Arrow	A	A	A	A	A	A	A	A	Arc	Arc
" " Com'l.	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Premier	A	A	A	A	A	A	Arc	Arc	A	Arc
Regal	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
(8 cyl.)							A	A	A	Arc
Renault (French)							A	Arc	A	Arc
Reo	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Riker	A	E	A	E	E	E				
Saxon	E	E	E	E	E	E	E	E	E	E
Selden	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (5½ ton)					A	Arc				
Simplex Crane			A	A	A	A	A	A	Arc	Arc
Stearns-Knight	B	A	B	A	A	A	B	A	B	A
Studebaker	A	Arc	A	Arc	A	Arc	A	Arc	Arc	Arc
Stutz	A	A	A	A	A	A	A	A	A	A
Velie (4 cyl.)									A	Arc
" (6 cyl.)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (1 & 1½ ton)	Arc	Arc	Arc	Arc						
" (3½ ton)	A	Arc	A	Arc						
Westcott	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
White	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (Sixteen Valve)	A	A	A	A	A	A				
White (3 ton)	A	A	Arc	Arc						
Willys-Knight	B	A	B	A	A	A	B	A	B	A
Willys Six	Arc	Arc	Arc	Arc	Arc	Arc				
Winton	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc

VACUUM OIL COMPANY NEW YORK, U.S.A.

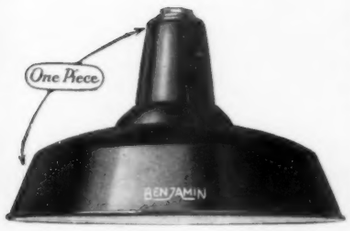
Correct Light

The Fundamental of Industry

Correct light *is* the fundamental need of industry. Upon the degree of efficiency attained in industrial illumination depends the degree of efficiency obtained from men and machinery. Production lags and quality sags under the handicap imposed by incorrect lighting.

The Benjamin Electric Mfg. Co. has devoted years of attention and effort to the development of correct illumination for industry. Within this organization, the inventiveness of pioneers and the skill of engineers are in constant activity. As a result, Benjamin lighting equipment stands unsurpassed.

Without obligation, the services of Benjamin illuminating engineers are at your disposal. They will be glad to plan an economical and efficient system of correct illumination for your particular plant. Or, if you prefer, ask us to send some informative material on lighting to your own engineer, contractor or architect.



The Benjamin RLM Standard Dome Reflector Socket

A lighting unit conforming to the specifications of the Reflector and Lamp Manufacturers and the requirements of the most exacting lighting codes. It is made in one piece without welded joints—an unusually strong, weatherproof, wear-resisting piece of apparatus. Unsurpassed for general illumination. This is only one of the complete line of Benjamin Reflectors—a line which includes a scientifically correct type of reflector for every industrial need.

Interesting literature is free. Address requests to Advertising Department, 806 W. Washington Blvd., Chicago.

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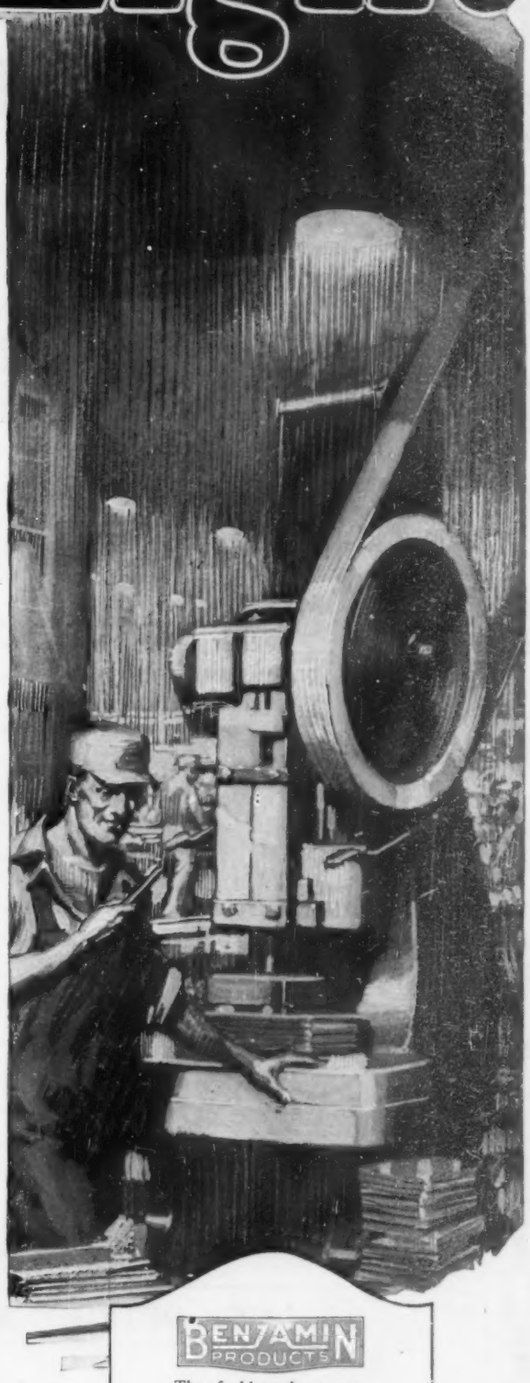

BENJAMIN PRODUCTS

The following are divisions of Benjamin Products on which the Advertising Department can give information.

Industrial Lighting Division
Electrical Division (Including Benjamin Two Way Plug)
Pressed Steel Products Division
Enameled Products Division
Starrett Panel Board Division

BENJAMIN

Makers of Things More Useful

The Story of the Paige Truck

When our Government declared war against Germany, truck making was a rather inexact science. There were many good trucks on the market, but all of them possessed inherent weaknesses that were in process of correction.

So the War Department asked American truck makers to pool their resources and experience and concentrate, as a body, upon the production of a brand new model.

One result of this co-operative plan was the standardized army truck—a truly wonderful vehicle for the conditions which existed on and around the battle fronts.

Another result was a sweeping revision of ideas and methods in regard to truck engineering and designing.

Old mistakes were routed out and discarded over night—newer and better ideas were conceived, tested and applied with great success.

The *modern* truck had arrived.

At this time, fortunately, the Paige Truck was merely a blue print. There was no truck plant to be remodeled—no expensive machinery to scrap—no equipment to discard.

So our designers simply tore up that blue print and made a new one that included every advanced thought in the truck industry. Then new machinery was purchased and installed in a new factory for production.

Such, very briefly and incompletely, is the story of the Paige truck. To the intelligent man it must speak volumes, for it affirms that the Paige is a strictly modern product—the last word in efficient truck design.

It explains why this new unit of the Paige line has been so promptly accepted as "The Most Serviceable Truck in America."

PAIGE-DETROIT MOTOR CAR CO., DETROIT, MICHIGAN

PAIGE

The Most Serviceable Truck in America

MOTOR TRUCKS

SEVENTY-FIFTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXXI.
NUMBER 8

NEW YORK, AUGUST 23, 1919

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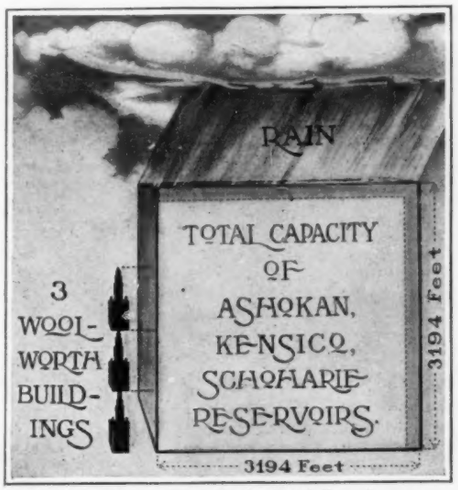
Some Damp Reflections

WHEN one is caught out without an umbrella, it often seems as though all the water in the world were concentrated in a very small area; but as a matter of fact, it takes very little water to make one thoroughly wet and disconsolate. It is not much consolation under such circumstances to realize that there is a great deal more water somewhere else than there is running down one's spine and into one's eyes; but for such consolation as it may be worth, we can calculate that a single inch of rain descending on the City of New York means that more than 5,460,000,000 gallons of H_2O have been precipitated, and would be standing on the city in an aqueous blanket if there were no drainage. A single shower with a fall of an inch would be remarkable, though not unprecedented, but a prolonged storm almost always brings down a good deal more water than that; so we are not stretching the verities when we talk about an inch of rain in New York. The weight of such a rainfall would be about 22,800,000 tons.

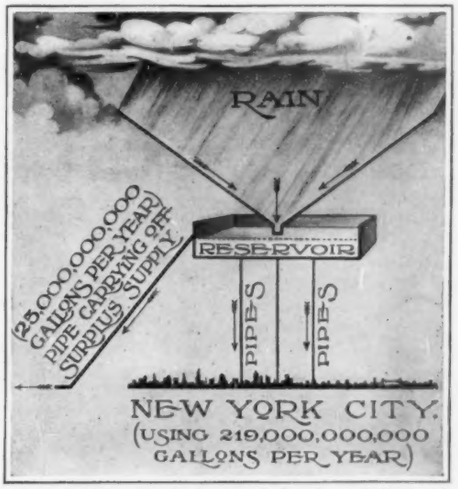
These figures are formidable enough, but they pale into insignificance when we consider the annual precipitation in our metropolis. The average annual rainfall for New York city is 44.6 inches. If this amount of water were confined where it fell, there would be almost 244,000,000,000 gallons of water over the city's surface. When we reflect upon the disposal of this, or any considerable fraction thereof, all in one piece, we may be thankful that rainfall does not accumulate, but that the year's blanket of 3.7 feet of water runs off as fast as it falls.

If, however, there were some way of retaining all this water, and at the same time retaining control of it, the vast expense of bringing water to the city would be eliminated entirely. For the daily consumption of water in New York approximates 600,000,000 gallons; so a rainfall of one inch, if it could be conserved in its entirety, would supply the citizens with enough water for nine days. The entire year's rainfall would actually give enough water to last for 400 days, so that the city would have an oversupply of some nine per cent if the rain could be utilized *in toto*. Of course it is out of the question to attempt anything of the sort, so these remarks, in a way are on a par with the findings of the worthy gentleman who calculates how many times the chewing gum that is consumed in the subway would extend to the moon and back; but they are at least interesting as indicating graphically the magnitude of the rainfall, when we come to sum it up over any considerable period. To carry the matter a little further along this line, we will see that in a century, enough water falls on the Big City to bury it beneath a lake 370 feet deep, containing 24 trillion gallons, and weighing a mere trifle of 100 billion tons. At this rate, the Woolworth Building would go out of sight in about two centuries, if the water held out.

It is not easy to realize how much water is involved in rainfall. An inch of rain means that there has been precipitated on each acre no less than 100 tons of water.



The 244 billion gallons of rain that fall each year on New York city would fill a cubical reservoir 3,194 feet on a side



If this water could be impounded and used, it would meet all the city's needs for the year, with a good surplus

Present Striking Use of X-Ray in Metallurgy

PROGRESS in the examination of solid materials with the X-ray has been rapid in recent months and some surprising results have been recorded. This is particularly true of British and French research. The facts were brought out at a recent meeting in England.

One of the earliest applications of the X-ray to metallurgy was in the detection of flaws in steel and other metals. Recent experience shows that, with the present apparatus available, it is possible to detect very small flaws in steel two inches thick. London experimenters announce, however, that apparatus has lately been devised with which it is confidently expected to penetrate steel up to nine inches thick. French cast-steel brackets for gun carriages have been shown by this test to be faulty, and the method of manufacture was changed resulting in a correction of the defects. The entire internal structure of cartridges and high explosive shells has been profitably examined without injury to the object and welds have also been found imperfect by the same agency. The application of these developments opens up a wide field of advantage to the metallurgist.

Still more interesting is the possible use of the X-ray in analysis. When the percentage of an element of high atomic weight such as tungsten is considerable, as in tool steel, the metal is not so permeable to the rays as when the percentage is low. It appears possible to apply radiography to rapid analysis in particular cases, as the separation of carbon from tungsten and alloy steels.

Another valuable development involves the examination of carbon electrodes for electric furnaces. The suggestion is made that the best use of radiographic examinations would probably consist in systematic experiments on electrode manufacture where variations in composition, baking temperature, etc., would proceed step by step. Internal causes resulting in premature and frequent breaking in service may thus be detected. Already the visual examination of aircraft timbers has yielded valuable results. No difficulty has been found in detecting concealed knots, resin pockets and grub holes, or excess or deficiency of glue in glued joints.

Examination of materials without destruction of the object has been a desideratum for many years. Its partial realization seems nearer as investigations proceed. Not only radiography but magnetic analysis are important factors in this evolution. Further work must decide to what degree these new developments in radiography will result in non-destructive testing. Already the results are striking and the goal nearer.

Power from the Tides

A SCHEME for the generation of electricity from the tides put forward by J. Smith, of Glasgow, Scotland, depends on the alternate use of two or more estuaries or arms of the sea having different times of high water, and in this respect it bears some resemblance to a plan suggested by another Britisher last fall. Mr. Smith takes on one hand the Severn at Portishead, and on the other the Dee at Point of Air, the Menai Straits, and the Mersey above Liverpool Docks. Of the 34-foot rise and fall of the Severn he would use only half, or 17 feet, and on a similar basis he reckons on 14 feet for the Dee, 14 feet for the Menai Straits, and 13 feet for the Mersey.

According to his proposals, on rising tides the water would run through the turbines into the inside of weirs, and on ebbing tides through the turbines into the outside of the weirs, the outlets and inlets being so arranged that the turbines would always revolve in the same direction. All the doors would be closed at low water, keeping out the rising tide, and also at high water, keeping in the full tidal water. All the rivers would start their turbines at half-tide, rising or falling. There being about three hours between the times of high water at the weiring points on the Severn and on the other rivers, the Severn would get three hours' run, starting at half rising tide with a head of 17 feet (the inside water being at low water), and finishing at high water, 34 feet minimum tide. The other rivers, being now at half rising tide, would take over the working from the Severn until high water on them. Then the Severn, having receded to half tide and left the inside of the weir full of water, would again take over the working and continue down to low water. The turn of the other rivers, now at half ebb tide, would then come again, and when the tide on them had fallen to low water the Severn would have advanced to half tide and would again come into action.

When the working time of the turbines was over, there would still be the head of water to be disposed of quickly; this would be done by allowing the turbines to run beyond their time and by opening very large sluices below them, the channels being large enough to clear away the surplus water in about 20 minutes. Mr. Smith claims that by this method some five and one-half million horse-power could be obtained, and that current could be distributed at one-thirtieth of a penny per unit.

A vast number of projects for tidal utilization has been put forward at one time or another; but the inherent drawback has always been the utterly intermittent character of the power which could be obtained, and its tendency to maxima and minima. The present scheme seems to be about as good an effort to avoid these objections as we have ever seen.

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

The High Cost of Loafing

WE are confronted by a condition, not a theory. Prices are high, and show tendency to go higher. Wages are high, with an upward trend. When prices rise, wages must follow; when wages go up, prices must keep pace. The wage-earner demands that prices drop while wages remain stationary or even continue to go up; the employer of labor has about given over hope of declining wages, but insists that prices must rise while wages stay put. And between the two millstones, right in the dead center of the vicious circle, are some millions of salaried workers who call upon Heaven to witness that whatever happens they must pay.

To the demand for a solution of this puzzling mess there are many answers. We are not going to invade the field of the economist to venture an opinion upon the thousand and one panaceas that have been put forward, for we are not at home in that field. But there is one proposition which can be supported without any knowledge of the mysteries of economics; one that is mathematical in its simplicity, direct in its bearings, and clearly within our field.

If we hire a boy to pick blueberries at a dollar a day, and he picks ten quarts, the cost is ten cents per quart. If he doubles his output he cuts the cost to five cents. If he knocks off in the middle of the day to go swimming, and reports at quitting time with only five quarts, the cost goes up to twenty cents a quart; and if he himself comes around the next day to buy blueberries, he may kick at the price based on this figure but he must pay it.

All this is plain enough. There is no reason why the application of the principle in other fields should not be equally plain. If a linotype operator or a lathe hand or a carpenter or a railroad repair man or anybody else in the world loafs on his job and thereby cuts down his production, he automatically increases the cost per unit of his product. If he is working for the Government he may not thereby increase its price to the consumer—which means himself and everybody else; but even the Government, while it doesn't have to earn its keep, has to meet its deficits, so he at least raises taxes—his own and everybody's else.

In no uncertain terms Mr. Wilson pointed out to the railroad men that the remedy for high prices is not decreased production. His remarks had to do with production decreased through organized refusal to work at all; they are just as applicable to individual refusal to work, to work full time, and to work effectively. The world faces a shortage of every manufactured article, and at the same time a shortage of labor. It is perhaps natural, now that there are more jobs than men, for the worker to relax his efforts. It is understandable that he should feel that he need not hustle and that he is not going to hustle. But there will not be lower prices until he gets rid of that feeling.

The law of supply and demand is still doing business at the old stand—even in Russia, where it was officially abolished. If demand exceeds supply, prices *must* rise until demand drops to a level with supply. The only way you can possibly make 100 pairs of shoes go around among 200 prospective buyers is to put the price where half the buyers can't reach it. On the other hand, if supply exceeds demand, prices *must* fall until they attract new buyers to swell the demand.

If the world is short of sugar and shoes, steel and wool and copper, automobiles and ships and houses, coal and wheat, the remedy does not lie in producing less of these things. This is plain to the point of absurdity when thus put down in black and white; in practice, where it can be obscured by a hundred considerations which really have nothing to do with the matter, it may not always be so plain. It is always true, however, and always inescapable. There is just one way to force prices down under present conditions—that is for us all to pitch in and produce so much of everything that at the same time prices can and must go down. Cut the cost and boost the supply and prices must drop. But as long as we go on cutting the supply and boosting the cost by loafing on our jobs, prices will hold their upward course.

Hobbies and Hobbyists

EVERY one of us, if he does not collect stamps or coins or Indian relics or books or prints or pictures or some other more-or-less familiar objects of art or curiosity, must have acquaintances who are smitten by the collecting hobby. Indeed, one anthropologist has recognized a collecting instinct, which all of us possess in greater or less degree, and which is one of the things that distinguish the human race.

Now we submit that this viewpoint is inadequate. For one thing, it fails properly to distinguish between the various types of collectors. We think these are sufficiently diverse to make it out of the question to attribute all their vagaries to the single impulse. Surely we must agree that at the very outset we have two totally different varieties of *Homo Acquisitivus*—the man who draws his pleasure from the having and hoarding of his treasures, and the one who gets all his fun in the mere act of acquiring them.

We know stamp collectors, for instance, who have made and sold a dozen collections, simply because after attaining a certain degree of completeness the addition of further stamps which they still lack becomes such a rare occurrence that there is no longer sufficient action in the hobby for them. Collectors of this type sell this week and next week are deep in the formation of a new collection. They pursue the objects of their quest to the ends of the world; but after finding them, their interest flags and they get no pleasure out of mere possession.

Opposed to this sort of hobbyist is the man whose whole existence is wrapped up in his collection. He too pursues assiduously; but for the joy of having, rather than for that of acquiring. As a philatelist he arranges and rearranges his stamps, never satisfied that he has them displayed to best advantage; as a numismatist he boasts that he has never sold or "swapped" a coin, but still retains every one he ever owned; as a collector of paintings he spends his time in his gallery gloating over his canvases. In a sense he is a miser in his particular field. And when we make this remark, do we not make it clear that our multi-millionaires are collectors of wealth, and that they may be classified here, too?—a Carnegie, for instance, in the group of acquisitors, who do not care greatly about their wealth save in the accumulation of it, and a Russell Sage among the misers.

But this is far from being the only classification to which the collector is susceptible. For instance, there is the man who delights in exhibiting his treasures, and the man who keeps them for his own eye alone. Do not think that this is but another way of defining acquisitors and misers; the worst philatelic hoarder of our acquaintance insists on showing his stamps, though he is so suspicious that it costs him misery to allow another within reaching distance of them. On the other hand, collectors who display the peculiar variety of acquisitiveness which takes delight in buying an object because some one else wants it, and who would look with contempt upon an article of the greatest rarity if it were not necessary to snatch it from the very clutches of a rival, are notoriously inclined to secrete their collections and keep them from all eyes save their own.

Then we can classify collectors according to the sort of objects and the sort of achievement that appeal to them. One man deliberately collects a line in which many others are active, in the expectation of forming a collection which shall outrank all competitors. Another takes delight in the single elements of his collection, and is highly incensed if you speak of the size of his accumulation, or attempt otherwise to rate it as a whole. Still another finds his joy in the selection of a field which is unoccupied, so that not merely the elements of his collection, but the collection itself, is unique. He will collect street-car transfers until he learns that there is a man in Kalamazoo pursuing the same hobby, whereupon his collection at once becomes trash in his eyes, and he turns to the accumulation of colonial well-buckets or fish-eyes. Again, there is the man who speaks of every item in terms of its cost, while across the way a collector of the same field talks rarity and condition, and would slay you with a glance if you drag in the sordid consideration.

On the whole, it's a queer world we live in.

Coöperation in Scientific Research

FOR the ravages and economic difficulties resulting from the world war we may as well extract what comfort we can from reflecting upon the valuable lessons which it has taught us. Indeed, it is more than merely a matter of seeking comfort. If we fail to profit by the experience, so much will be added to the disaster.

Second perhaps to none in importance, among the revelations of the war, are the latent possibilities of coöperation in scientific and technical research. Only those who were directly connected with scientific work in relation to the conduct of the war can fully appreciate the significance of this fact. We are told, for example, that in a single two days' conference of American plant pathologists, by the free interchange of facts and ideas, more progress was made in the solution of the difficult problems of leaf roll and mosaic, than would have been secured in five years of scattered individual effort. And this is but one instance of the tremendous gain which such coöperation has brought.

In scientific and particularly in technical research lack of coöperation means not only needless duplication of effort, but incalculable loss through arrested development. It is often the combination of the ideas of two or more individuals that furnishes the solution of a problem. When these ideas are not brought together, they cannot combine. Hence it follows that free interchange of thought accelerates progress in altogether incalculable proportion.

Yet a species of pardonable professional jealousy, or the fear of giving aid to a competitor in trade, has long been allowed to place obstacles in the way of such interchange of ideas. A less self-centered attitude in these matters cannot fail to bring advantage to all. The present economic situation should cause us to give most careful heed to these things.

That part of the increase in the cost of living which is due to monetary causes—to the increase of gold in circulation and to the expansion of credit—is in a sense not the most serious, for it can be taken care of by correspondingly increased wages. If the cost of living, measured in dollars, were doubled, and wages also were doubled, we should be as well off as before. Real hardship comes only if prices advance at a more rapid rate than wages. Whether this takes place or not depends—aside from unjust operations of monopolists and profiteers—very largely on the productive efficiency of our industries. And we may well doubt whether any one single agency equals in its latent power to multiply this efficiency, the almost untapped reserve of coöperation in scientific and technical research.

To Our Subscribers

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Engineering

Searching for Blow Holes With the X-Ray.—Roentgen rays are now used to test the quality of cast metal and discover any internal defects. They offer an excellent method of determining the influence of aluminum and tungsten on steels. Castings an inch and three-quarters thick may be penetrated by the rays disclosing blow holes and similar flaws.

An Upstairs Swimming Tank.—The customary and most natural location for a swimming tank is in the basement of a building, but in the new home of the Omaha Athletic club it was decided to put the swimming pool on the third floor where it would be readily accessible to the gymnasium and locker rooms. The tank is 76 feet long and 26 feet wide, holding 120,000 gallons of water, weighing 500 tons. The swimming tank has called for an unusual construction, the fifth floor being carried on heavy girders that span the swimming pool, while the fourth floor which is in the form of a balcony around the pool is suspended on hanger rods let down from the fifth floor girders.

Building a Dam Foundation With Hanging Caissons.—The use of suspended caissons is rather unusual in engineering work and particularly the construction of concrete caissons in the suspended position. Spanish River at High Falls, Ontario, flows through a rocky gorge that is only 135 feet wide. The water rises from a normal depth of 45 feet to 55 feet in time of flood and pours as a torrent through the gorge, here a dam is being constructed. Caissons are being sunk above and below the dam and sheet piling will close the gaps between them so as to form a cofferdam and permit of unwatering the intervening area and laying concrete in the dry. Temporary pile stagings were built on which timber trusses were supported. Platforms were suspended from the trusses and on these the concrete caissons were built. Threaded rods embedded in the deck of the working chamber were used to lower the caisson and as it was lowered it was extended by building additional sections above.

What is Pulverized Coal?—In a recent paper presented before the American Society of Mechanical Engineers Mr. N. C. Harrison defines pulverized coal as coal that has been reduced to such fine particles that at least 95 per cent will pass through a 100-mesh sieve having 10,000 openings to the square inch. In other words 95 per cent must be less than one two-hundredth of an inch cube. He goes on to say that "the average person does not fully realize to what a high degree of fineness it is possible to reduce the coal today by pulverization. The finer the coal is pulverized the more efficiently it can be burned and the more readily it will be diffused when mixed with the air for combustion and fed into the furnaces. Pulverizing certainly does not change the nature of the coal, but it does change its form to a certain extent in that the coal is changed from a solid into a fuel having liquid properties. As the coal is pulverized it is mixed with air, and when handled in the conveyor it flows like water; when fed to the furnaces it is more or less like a gas, and the furnaces must be designed to burn a gaseous mixture."

Letting a Stream Lay Its Own Flooring.—A novel bit of engineering work was recently carried out in the Little River Drainage District, Missouri. A section of the drainage channel which was contracted in order to control the flow from a basin, began to suffer from erosion. The banks had been protected with riprap but it had not been thought necessary when the channel was excavated to protect the bed of the channel as well. It was determined to floor the bed of the stream with boards, weighting them down with riprap. Wires were stretched across the stream and on them was constructed a board mattress 40 feet wide and 300 feet long. The boards were laid in the direction of the channel and were transversely wired and cross poles were lashed to them to hold them together and also to assist in keeping the riprap in place. When the mattress was completed the upstream end was sunk by weighting it with stone and, as the water rushed over it, it bore the entire mattress down by its own weight. The wires stretched enough to let the mattress sink and they were successively broken with a blow of a hammer. A couple of stout cables at the upstream end kept the mattress from dragging and crumpling before the riprap could be deposited on it.

Astronomy

Dr. Milan Stefanik, formerly attached to the Meudon and Mont Blanc Observatories, was recently killed in airplane accident while serving as a general in the French Army. In 1910 Dr. Stefanik, established at his own expense an observatory in Tahiti. In 1911 he was awarded the Wilde prize by the Paris Academy of Sciences.

The Cawthron Solar Observatory.—It is reported that Dr. G. E. Hale, director of Mt. Wilson Observatory is to prepare the plans for the equipment of the solar observatory which is soon to be built at Nelson, New Zealand, with funds provided for the purpose by the late Mr. Cawthron. It is planned that the observations secured at the observatory shall be reduced and discussed in America; probably at the Mt. Wilson Observatory.

Martian Snow Cap and Solar Activity.—The eleventh report of the Mars section of the British Astronomical Association, published in April, 1919, deals with the apparition of 1913-14. Drawings and observations are contributed by seven members. The director, M. Antoniadi, was unfortunately not able to make use of the 32¾-inch Meudon refractor, which he has used at previous oppositions. The most interesting feature of the apparition of 1913-14 was the exceptionally slow diminution of the north polar snow cap, and the coincidence of this fact with the great mininum of solar activity. M. Antoniadi states that a detailed study of the phenomena proves that the shrinkage of the snow cap lagged behind the normal much more than at any time since 1864, as if solar heat were lower in 1913 than during any of the 10 previous apparitions of Mars in which the planet was observed partly or wholly in the same heliocentric longitudes.

Curious Phenomena in a Lunar Crater.—Signor Mentore Maggini, of the Observatory of Florence, Italy, describes in *l'Astronomie* some observations made on the evening of October 10th, 1916, when he was engaged in studying the numerous little craters in the interior of the great lunar crater Plato. He was surprised to find that one of these craterlets, No. 59 on Pickering's map, was invisible, though usually distinctly seen under the conditions of solar illumination then prevailing. Moreover the neighborhood of this craterlet was seen to be involved in a reddish shadow, which later invaded the whole northeast portion of the main crater wall. Eventually the reddish shadow disappeared and craterlet No. 59 became visible. The effect suggested the appearance of a nitrous vapor, and this observation coincides with others that have been made from time to time in the same crater, the curious changes in which have been plausibly attributed to the presence of clouds of volcanic gas proceeding from the moon's interior. A resumé of recent observations of the same general character was given in the seventh report of the lunar section of the British Astronomical Association, published in 1916.

The Solar Constant.—For the past 14 years the Smithsonian Astrophysical Observatory has been measuring the solar radiation and calculating its variations. During the earlier years of the investigations conducted at Mt. Wilson, Cal., it appeared that the values found varied from day to day, and from year to year. The results secured by comparing data secured from observations made simultaneously in California and Algeria support each other, and indicate that the variations are due to cause outside the earth's atmosphere. Further observations conducted by the Smithsonian expedition in Calama, Chile, and similar observations made in California, mutually support each other as to the variability of the sun. One scientist was so strongly convinced of the dependence of the weather on solar radiation, that at his suggestion, the Argentine Government is obtaining daily telegraphic reports on the solar radiation at Calama, Chile, upon which are based temperature forecasts for Argentina; and the Brazilian Government has adopted the same system. It probably will be necessary within a year or two to equip additional solar radiation observing stations in the most cloudless regions of the earth. During 1918 the solar radiation was above its normal; an average value of 1.95 calories per square centimeter, per minute were measured at Mt. Wilson and Calama, whereas the mean value for many years is 1.93 calories

Electricity

Electrolytic Copper from Chinese Coins.—As a consequence of the large demand for electrolytic copper during the war, the price advanced very greatly and many concerns for manufacturing this product were opened in Japan. The raw material for this industry was obtained from the Chinese bronze coin, which was imported into the country in large quantities until the Chinese government prohibited its exportation. At present the prices of electroytic and ordinary copper varies so slightly that it does not pay to manufacture the former. Copper sheet manufacturers are also hard hit by the decline in prices and some of the large concerns are suspending operations or giving up this branch of business.

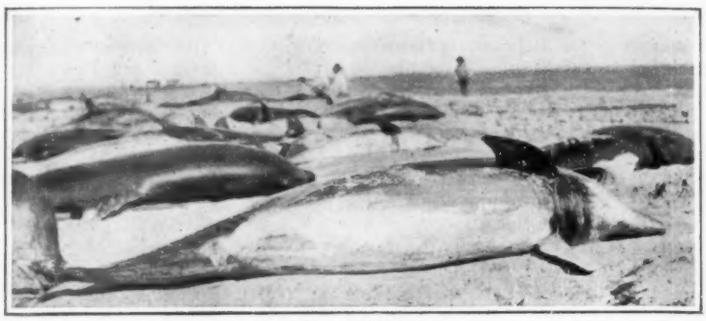
Wireless Telephony in Great Britain.—Wireless telephones were used as a medium through which British R. A. F. officers flying over central London on May 14th last addressed the members of the Institution of Electrical Engineers assembled at a lecture being delivered by Major Ers'kine-Murray on "Wireless in the Royal Air Force." The London *Daily Mail* reports that the strident voice of one of the airmen was heard coming from a trumpet-shaped instrument on the platform, describing his flight at a height of nearly 3,000 feet. The conversation ended only when the pilot announced that he was "getting fed up." The machine stayed in the air long enough for the officers to listen to and acknowledge a round of applause from the audience.

Electrification of Belgian Railroads.—The Minister of Railways has approved the project of the electrification of Belgian railways, and Mr. Lamal, Administrator of Railways, Messrs. Foulon & Robert Chick, engineers, and Mr. Colson, chief electrician, have been instructed to submit plans by August next for the electrification of the line between Brussels and Antwerp and Brussels-Luxembourg, to be followed immediately with an electric line between Brussels and Ostend. The current will be supplied with overhead wires or the third-rail system, according to the location and circumstances. Work will be commenced at the beginning of 1920, and it is proposed that the journey between Brussels and Antwerp be made in 25 minutes and to run trains every 15 minutes.

Novel Radio Telegraphy Device.—According to a Norwegian newspaper, an engineer by the name of Hermod Petersen has recently patented a device for the production of electrical current for radio telegraphy. The electricity is received by an accumulator, which releases it at certain intervals. The system is sparkless, and the sounds are clearer than in the older inventions. The clearness of sound depends upon the regularity of the current, and with this system the current is released with a mathematical exactness. The device has further advantages in that it is cheaper, simpler, and more durable than those now in use. If the claims made for this invention prove well founded, it is thought that it will mark a distinct step in advance of what has so far been accomplished in this line, and hence its possibilities are creating considerable interest in the radio world.

Electric Super-Submarines.—Designs for a new type of super-submarine have been elaborated by Capt. Norman Wood, R. A. F., who recently read two papers on the subject before the Institute of Marine Engineers in London. Previous to his connection with the Royal Air Force, Captain Wood was engaged on submarine work and had practical experience of the deficiencies which exist in the design of even the latest vessels. On the surface submarines are driven by Diesel oil engines; under water they are driven by electricity from storage batteries which must be charged when the vessel is on the surface. These conditions are usually met by arranging the following chain: (1) Diesel engine, (2) clutch, (3) electric motor, (4) clutch, (5) propelier shaft. It is not difficult to see that this equipment involves a complex series of operations at critical times, as, for instance, when the vessel is caught by an enemy searchlight when the batteries are being charged. Captain Wood, continues *Electrical Review*, proposes to simplify the transition from engine drive to motor drive (or vice versa) by adopting an all-electric drive, using, in a 1200-ton boat, two oil engines to drive electric generators supplying current to electric motors used on propeller ships, both naval and mercantile, on the ground that the growth of air power will render submersion the only means of escape from aerial attack. From this standpoint sea power will include air power and submarine power as well as strength in ships of the old type.

Skinning the day's catch



A big haul of blackfish

Leather from the Sea

Giant Dwellers in the Water Who May Be Called Upon to Make Good the Shortage of Hides

By Robert G. Skerrett

HERETOFORE, with minor exceptions, we have depended upon the skins and hides of land animals for the great bulk of our leather stocks. Today, because of the reflexes of the war, and owing to diminished if not totally destroyed herds of cattle, sheep, goats, etc., we, with other peoples, are face to face with an unprecedented shortage of leathers. And, what is equally disquieting, this scarcity is going to lay a tax upon all of us.

The pinch upon our purses will come home most directly through the added prices that are certainly going to be charged for our footwear next fall and winter. The average pair of shoes will cost us something like a dollar more if the experts of the leather industry be correct in their prophecy. That is to say, the nation as a whole will have to hand out for its boots and shoes a matter of $100,000,000 additional to cover its feet in the course of the next six months without gaining anything in the way of improved articles.

We are accustomed to boast of our self-sufficiency when it comes to raw materials, especially. It will, therefore, probably shock many good Americans to learn that the United States commonly relies upon the outside world for nearly half of its cattle hides, for well-nigh all of its goat skins, and likewise for a very large part of the pelts of sheep and calves consumed here. From an industrial point of view, the present leather shortage and outlook become even more serious when we recognize the fact that we have grown to be the leading nation among those manufacturing boots and shoes. What are we going to do to make up the existing scarcity and to insure our factories against shut-down or woefully diminished output?

During 1917 we imported 700,000,000 pounds of hides and skins, valued at the ports of entry at $216,000,000. Since then, there has been a notable decrease in the quantities of leather stocks brought into the United States, and this falling off has reached hundreds of millions of pounds. Only a part of the leather worked up here annually goes into footwear. Much of it is demanded by the upholsterer; great quantities of it are used in the making of harness and saddlery; the glove trade levies a big toll; and then its employment is varied in the fabrication of traveling bags, handbags, pocketbooks, and an endless multiplicity of other useful as well as ornamental articles. In the field of mechanics, leather meets with peculiar fitness numerous needs, and the whirring wheels of our factories and other services calling for power transmission would be at a loss if a sufficiency of leather belting were not available. Finally, the automobile and aircraft have brought to the fore the advantages of leather in providing especially suitable garments.

Manifestly, the demands for leather stocks are certainly going to increase rather than to diminish; and if the herds, the droves, and the flocks of land animals are inadequate, from what other sources can we obtain skins susceptible of being tanned and made fit to meet these manifold services? Happily for us the period of strife has stimulated research and brought about material achievements which otherwise might still be remote potentialities. Quite two years ago, the Department of Commerce urged the experts of the leather industry to see what they could do here towards successfully tanning the skins of a number of marine mammals and fish.

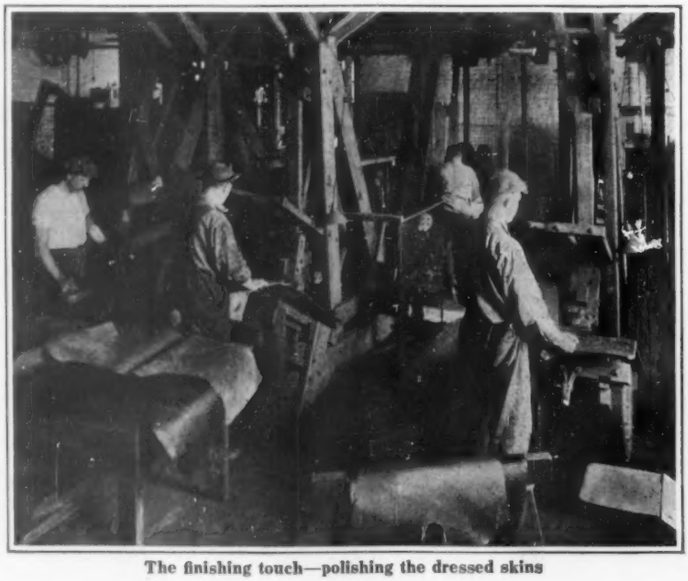
Previously, the skins of some domestic porpoises had been tanned but not in sufficient measure to loom at all conspicuous in the volume of the native leather industry. There were two reasons for this. First, the catching of the porpoise was an infrequent occupation and we had little if any trouble in securing from long-established sources the desired amounts of leather stocks; and, next, porpoise leather for boots or shoes found only a limited use owing largely to the fishy odor that clung to the finished product. The more common employment of the leather was in the form of shoestrings. In England, on the other hand, for a good long time, the tanners have been producing a fine grade of so-called porpoise leather from the skin of the beluga or white whale, which attains a length of 18 feet or more and will average in girth from 10 to 12 feet. This leather has great tensile strength and is remarkably well adapted to the making of machinery belts; and because it keeps its shape under varying stresses it is admirable for working into shoes. The beluga abounds in the waters contiguous to the northern coasts of this continent.

WHERE are the shoes of tomorrow coming from, and how much will they cost their wearers? With the familiar leathers high beyond precedent and admittedly going higher, these are questions of the hour. The difficulty here seems, far more certainly and far more generally than in some other fields, to be due to a fundamental and inevitable shortage of the basic material—hides. The answer therefore lies in the direction of new sources for leather; and in this article one such source is discussed, in the light of the very most recent investigations which have been made into the subject.—THE EDITOR.

The most significant development in the art of converting the skins of aquatic creatures into leathers of excellent grades is that now being pursued upon a commercial scale in dealing with the hides of sharks, rays, dogfish, blackfish, etc. Despite the fact that many firms, encouraged by the United States Department of Commerce, failed to secure satisfactory results, one New York concern has solved the difficulty that has hitherto baffled the tanner. One of the early operations in preparing the skin of the aquatic animal for tanning is that of soaking the hide in a lime solution. If this is not done with extreme care and with due regard to the natural differences peculiar to the fish skin the resultant product is so spongy and lacking in strength that it has practically no market value. This stage of the process has pretty generally ruined the skin and made further work upon it quite useless. Today, the secret of a correct lime bath has been discovered, and, similarly, some other phases incidental to the manipulation of the skins have been mastered. Among these is a degreasing treatment which effectually removes the fishy odor.

The adaptation of the shark skin to the general purposes of the leather worker has presented distinctive difficulties—so, too, has the skin of the ray and the dogfish—because of the horny, tuberculous exterior which is frequently so hard that it can be ground down only by means of abrasive belts or wheels. In fact, this shagreen has been extensively employed by cabinet-makers, ivory workers, metal workers, etc., in lieu of emery cloth and sand paper. The question of making shark skins available for leather has, therefore, rested in part upon devising ways to get rid of the shagreen. The results as a rule have been anything but satisfactory, simply because grinding away what might be called the superficial hard material still left the supporting parts or bonds imbedded in the leather, to just that extent stiffening it, greatly hampering cutting and sewing, and yielding a product which had numerous drawbacks.

Thanks to recourse to chemistry, the shagreen can be completely separated from the underlying skin and yet leave the hide beautifully marked with its characteristic "grain." So dressed, the leather lends itself to the manufacture of bags, belts, card cases and other articles where an ornamental surface is desired. With this exterior removed, either the



The finishing touch—polishing the dressed skins

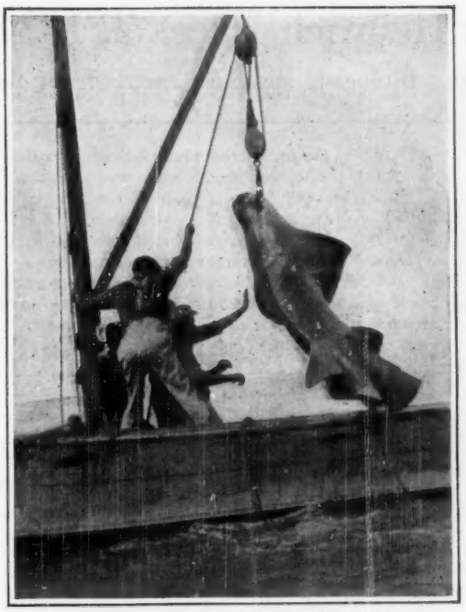
upper layer of the skin or the underlying "splits" can be dressed for shoe stock—including the heavy material for soles. The leather will take a beautiful finish and is notably durable. From a 500-pound shark it is possible to obtain ten square feet of leather from the hide, and the stomach furnishes a raw material that will yield a leather which is soft and strong and looks not unlike glazed kid when ready for the market.

The ray or devil fish will frequently provide a skin, when tanned, having an area of 100 square feet; and the sawfish is also a potentially abundant source of leather stock. The dogfish, being comparatively small, is not as individually profitable as the full-grown shark, and yet its hide is well worth tanning. The porpoise, depending upon its size, will give a skin susceptible of producing anywhere from 10 to 20-odd square feet of leather. Not only that, but from this skin can be taken a sturdy upper layer or grain of very fine quality and then two underlying "splits"—the first of these being thick and strong enough for a good grade of heavy shoes, while the second "split" is of the character of a thick suede. The intestines of the porpoise make leathers for which there are many uses. The skin of the blackfish and likewise the skin and stomach of the whale lend themselves to tanning, and from these several sources leathers of fine qualities can be secured.

But this whole question of "sea leathers" would make but a moderate appeal to enterprise and capital if it were not possible to utilize other parts of these aquatic creatures. From the livers of the shark an oil is obtainable, also from the livers of the dogfish, which is said to have much of the medicinal properties which characterize cod liver oil, and, besides, the oil is in demand for the manufacture of soaps, for mixing paints, and for the treatment of some leathers. A 500-pound shark will give an average of from 10 to 15 gallons of liver oil, which is easily marketable at fifty cents a gallon. The dorsal fins, when dried, bring $2.50 apiece among Oriental epicures. The teeth sell readily for five cents each to manufacturing jewelers who work them into ornaments of one kind or another. The flesh of the shark is said to be decidedly palatable, and the Bureau of Fisheries has published some thirty different recipes for fresh shark, smoked shark, salt shark, and canned shark. In common with the meat of other sea creatures, the flesh of the shark can be converted into fertilizer or dried and ground for chicken and cattle food. As a fertilizer the stuff is rich in ammonia and phosphoric acid. Sharks in our southern waters range from 400 pounds to 2,000 pounds in weight, while the devil fish or ray will frequently tip the scales at 3,000 pounds.

The porpoise, besides furnishing skins that can be tanned, yields three grades of oil—i. e., body, head, and jaw-pan. The latter is especially valuable as a lubricant for watches and other fine mechanisms and, today, fetches quite $50 a gallon. Certain parts of the skins of some of these aquatic animals—parts that are not worth tanning—contain fully 90 per cent of glue. Likewise, from the blood of some of these creatures is to be had the basic material for a superior kind of waterproof glue such, for instance, as is desired in the built-up stock now used in making airplane propellers and other wooden parts of the flying machine. From the intestines that cannot be worked into leather it is possible to get the gut for string instruments, tennis rackets, etc., and sausage casings, parchment stopper-covers, glue, and other marketable commodities. The point is, nothing need go to waste; and, at the same time, an inexhaustible source of leather stock is thus made available which heretofore has been almost entirely neglected.

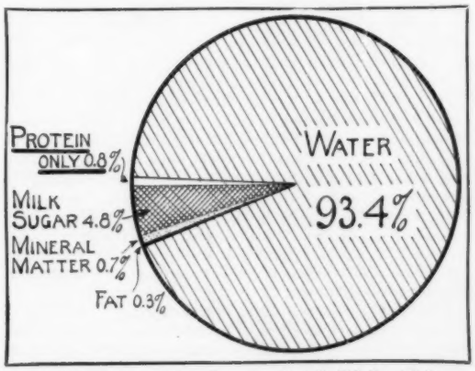
Stations for the taking of sharks, porpoises, rays, dogfish, etc., have been established by the successful "sea leather" company at Morehead City and Broad Creek, North Carolina, and Fort Myers and Sanibel Island, Florida. In those warm waters sharks and other large aquatic creatures abound. As a rule, five sharks are caught for every porpoise taken, and no one will regret the systematic warfare upon these voracious animals. Very long and big-meshed seines of extra-heavy twine, tap nets, gang hooks, etc., are used, and the bait commonly employed is turtle meat. Turtles are captured in goodly numbers. The shells are saved for the manufacturing jeweler and the maker of tortoise shell articles, while the flesh serves the purpose already mentioned.



Hauling a shark aboard from the seine

Barley Falls On Its Feet

DURING the war, when barley flour did yeoman service in eking out our supply of wheat, barley was high priced. Then, too, the brewers forced the price still higher by competing with the market. Now an unlimited supply of wheat and the prohibition movement have forced barley to depend upon its true merit as a food and a feed in the open market. Barley took a severe slump and is only slowly recovering.



Whey—it is nearly all water, but it did the trick

As there are several sections in the country where barley is the best grain crop, the experiment stations, notably that of Wisconsin, began extensive tests to determine the feeding value of barley in competition with other grains. Barley was fed to pigs to determine how it compares with corn, and what the results are when fed in connection with whey. It was found that the feed cost of 100 pounds of grain was only $8.83 with barley, while it was $9.92 with corn; and that therefore barley can acceptably replace corn in the ration of the hog.

It so happens that those States which have many cheese factories also raise much barley, and for this reason the experiment of feeding whey in connection with barley was of special significance. While barley is high in protein, it is not high enough. Whey is largely water, containing only .8 of one per cent of protein. The hogs ate barley and whey in about the proportion of one to two, which would leave the ration deficient in protein when judged by ordinary standards.

It was found that the pigs fed barley and whey gained more rapidly than those fed any other ration, the *quality* of the protein in whey supplementing the deficiencies of the protein in the barley enough to off-set the lack of quantity. Barley has thus fallen on its feet and earned an honored place among the other farm grains.—*W. A. Freehoff.*

Is This the Biggest Farm in the World?

ONE result of the Government's efforts to increase the production of wheat during the last two years has been the creation of the largest wheat farm in the world, some 200,000 acres of Indian lands in Montana and Wyoming. If this farm yields only 20 bushels per acre it will mean 4,000,000 bushels of wheat added to the 1919 crop, which at the government price of $2.26 per bushel, would be worth $9,040,000.

There are two other remarkable things about this farm: In the first place, it was conceived and is being managed by one man, Thomas D. Campbell, formerly a North Dakota farmer; in the second place, not a single horse will be in use on the property. Instead, huge tractors, the largest ever built, will do all the work of plowing, seeding, and harvesting. They will also do it more quickly than has ever been done by the use of horses. As a matter of fact, without tractors it would be impossible to run this big farm at all. The number of horses, or other animals, required would be prohibitive, to say nothing of the expense of feeding them and extra farm laborers to handle them.

The farm has been divided into units of 5,000 acres and to each unit has been assigned one giant tractor, with a dozen held in general reserve in case of accident. Each unit also has its own group of permanent buildings, modernly equipped, and is under the direct charge of a competent farm manager. Under this manager is a general foreman, who will see to hiring the help and getting the work done. But over all stands Mr. Campbell, who is constantly on the go from unit to unit, supervising the more important features of the entire job.

In the beginning Mr. Campbell figured out the whole thing: how much machinery would be required, and how much time should be allowed for plowing, seeding, harvesting and so on. Everything is done on a schedule and as this is dry farming land, no allowance has to be made for bad weather. The greater part of the plowing was done last fall. Some idea of the capacity of the huge tractors may be gained from the fact that fourteen of them plowed more than 350 acres in a day, none of which had ever before been broken by the plow.

Before he could lease the Indian lands Mr. Campbell had to make arrangements with Secretary of the Interior Lane. He was actuated purely by patriotic motives—to help the Government in its efforts to stimulate the food production. He stated frankly to Secretary Lane that he was willing to enroll with the dollar-a-year man if the Government financed the project, and if he financed himself he only wanted a chance to break even. The latter plan was accepted by Secretary Lane.—*Robert H. Moulton.*

Tractors at work on a huge farm laid out in Montana to help the attack on the high cost of living

New Chemical Journal

A NEW weekly chemical journal, the *Chemical Age*, was launched in England June 21st, devoted to industrial and engineering chemistry, and will fill somewhat the same field as that formerly occupied by the *Chemical World* which suspended five years ago.

Ernst Heinrich Haeckel, 1834-1919

The World's Ranking Biologist, and Last Survivor of the Darwinian Period

ONE of the few German scientists whose position is altogether too secure to be questioned is Haeckel, best known in this country as author of "The Riddle of the Universe." On Saturday, August 9th, he passed away in his eighty-sixth year. It is out of the question for us to find space for even a moderately complete account of his very full career; the accompanying sketch accordingly attempts only to strike the high spots.—THE EDITOR.

BIOLOGY, during the first half of the nineteenth century, was a dreary business of description and classification, with no promise of ever leading its devotees to anything better. It was held that all the members of the animal kingdom had been created in the beginning in precisely their present states; every class and order and genus and species was supposed to stand utterly isolated from every other class, order, genus and species. The justification for grouping the species at all lay in the bizarre notion that a genus, for instance, represented a truly natural group of species which had been conceived and created as variations about a single theme—just as the industrious space-writer might dress the same story up in a dozen different styles and sell it to as many different editors. That each class, each order, each genus, each species, maintained its individual identity absolutely unaltered from the beginning of time to the destruction of its final representative was the last thing that Cuvier and his disciples would have been capable of questioning.

Accordingly there was for the biologist nothing but description and classification—and argument with his fellows as to which system of classification best hit off the intentions of the Creator. The only thing he had to look forward to was the day when all living things should have been described, and classified according to a system accepted by all scientists. Biology would then be a finished science. But as for the construction of any body of theory, the deduction from observed facts of general principles, there was no room for this at all. Biology simply was not a deductive science, and never could become one. It was exclusively a science of observation, and of dispute over petty observational details.

Into this welter of meaningless triviality and fruitless bitter controversy Charles Darwin projected his revolutionizing doctrine. Many of his details, some even of the things which he would have recognized as main props of his structure, have had to go before the onslaughts of sixty years' further investigation. But the one fundamental idea which lay at the bottom of all his teachings has persisted and will persist. Species and groups are not self-sufficient and discrete; they are not even explicitly created; they just happen, merging into one another, arising from one another, with no definite line of demarcation; and the higher specialized types of animal life have evolved directly from the lower ones, so that the biologist can hope to trace back the line of ascent. Stripped of all details and subsidiary questions of how and why, that is what the doctrine of evolution comes to.

The significance of this to the biologist cannot be exaggerated. Where before, believing in the immutability of species, he was automatically excluded from broad general questions of theory, now he has such questions thrust upon him. He has a whole catechism to answer. Once he has accepted the fact that species can be and are transmuted, and that such transmutation is the means by which the vast observed differentiation of form has been attained, he must at once do what he can toward accounting for the mechanics and the causes of this. In a word, he must at once busy himself with the construction of that body of theory which his science has lacked. He will no longer simply observe; he must now observe and draw conclusions.

Now it goes without saying that such a radical departure as the theory of evolution could not become generally accepted without vast protest and a soul-satisfying fight. The question might appropriately be asked why Darwin was able to get his revolutionary ideas accepted, while other ideas, no more revolutionary and no more absurd from the standpoint of entrenched orthodoxy, never graduate from the "nut" class. Why could Darwin put his ideas across, while the man who insists that the world is shaped like a pear is only laughed at? Of course, one answer might be made that Darwin is right while the other man is wrong; but that answer is valid only after Darwin has been accepted. Moreover, if that were the only answer, the teachings of men like Bacon and Galileo must have been accepted during their lifetimes.

We would urge that the real reason why Darwinism swept over the world like wild-fire was because of the character of the first converts. Darwin was unbelievably fortunate in finding among scientists of standing, right at the outset, three disciples in as many countries who may fairly be characterized as zealots in the new science. Asa Gray in America, Thomas Huxley in Britain, Ernst Heinrich Haeckel on the continent; their enthusiastic acceptance and championing of the new teachings was the chief instrumentality in overturning the established foundations of biology in a few months and starting all over again on the new basis. The first thought of every biologist, on reading that Haeckel was dead in Jena, must have been that the last member of the quadrumvirate that revolutionized the science had passed.

The physical outlines of Haeckel's life can be given in a word; for he offered a startling contrast to the rolling stone. Haeckel and Jena are synonyms. For 58 years his only absences from the town and the University have been his field expeditions; save for these trips, his entire scientific career is identified with the little Saxon center of learning.

Haeckel was born in Potsdam on February 16, 1834. He passed through the Universities of Würzburg, Berlin and Vienna, taking his degree of M.D. in 1857, and in accordance with his father's wishes setting up practice in Berlin. But contact with men like Johannes Müller, Virchow and Kölliker had established his paramount interest in the general field of biology; and after a perfunctory effort at medical work he turned to the activities which he preferred. A conspicuous success in field work in the Mediterranean having brought his name into prominence, he was induced to come to Jena in 1861 as *Privatdozent;* the next year he became a regular professor; and in 1865 there was created for his incumbency a personal professorship which he retained until his semi-retirement in 1908.

Haeckel was just coming into his scientific maturity when the *Origin of Species* appeared in 1859. The new doctrines made a strong appeal to him, and he became the apostle of Darwinism in Germany. At the moment he was engaged in work with the *Radiolaria;* and when the monograph appeared in 1862 it treated the subject strictly from the Darwinian viewpoint. Four years later his book *General Morphology* was characterized by Huxley as a suggestive attempt to work out the practical application and the final results of the evolution hypothesis; and it stands as a landmark in biological history.

This work did not attract the attention which the author had hoped for; so after an interval of two years he decided to reissue it in more popular style, with some revision. The *Natural History of Creation* took the world by storm; from it Haeckel's outstanding supremacy among German biologists may be dated.

It was in connection with this revision that Haeckel put forward the Biogenetic Law with which his name is associated. This law asserts that ontogeny, or the life history of the individual organism, recapitulates phylogeny, or the evolutionary changes through which the species has passed in attaining its present status. It is under this law that we believe the human embryo displays at one stage the form of a fish because human ancestry is to be traced back to and through the fishes. In a word, the embryo, not alone human but of all animals, passes with great rapidity through a series of developments which constitute an epitome of the history of the race. The observed facts on which this law is based cannot, of course, be contradicted; and unlike many of the pronouncements of Darwin himself, Haeckel's deductions from these facts have stood very well the attack of later investigators.

Perhaps the most noteworthy thing about the great German biologist was his versatility. On the one hand he was always an unexcelled observer, painstaking and accurate; and it would be altogether tiresome to enumerate all his monographs. But even in these he displayed a grasp of the generalities, and an ability to go beyond a mere catalog of facts, which was far beyond the ordinary. In its totality, his output of descriptive work would have constituted alone a sufficient contribution for one lifetime; but in addition, Haeckel was at his best when writing or speculating on biological theory. It is seldom indeed that the ability faithfully to observe and collate data, and the capacity for drawing sound conclusions therefrom, are combined to such a degree in one person. Even a Huxley admitted that he lacked the patience for effective field work; and we need not mention names to demonstrate that the best gatherer of material frequently is lost when he attempts to tell what his material means. Haeckel's happy combination of these two kinds of ability was most fortunate; it will be realized that the establishment of the new biology would require such a man. In Haeckel it found him.

A noteworthy feature of Haeckel's work is his artistic ability. He was an excellent painter, so good, in fact, that he could have made his mark in that field. Indeed, though he deliberately elected to follow science rather than art, as offering a greater opportunity, his draftsmanship always stood him in excellent stead; for without his beautiful drawings, often made and reproduced in color, his monographs would lose much of their present value. Dr. Williams tells us that from a four-months' trip to India Haeckel brought back 200 water-color sketches made as a matter of recreation!

Another outstanding feature of Haeckel's character was his boldness to bring out, full blast, whatever he might believe he had established as true. Darwin waited twenty years before he published his *Origin of Species*, testing out his theories all the time; even then he hesitated to confront the learned world with them. No such caution was Haeckel's; the moment he was convinced that he had something, he would publish it or deliver it without reservation. This trait affords one reason why he stuck so faithfully to Jena, refusing many calls to more powerful institutions; for Jena is the one place in the world where academic freedom is such that a professor dare come out boldly against any orthodox pronouncement which he may see fit to attack. At times, indeed, Haeckel has seemed to verge perilously close upon the "yellow." For instance, he was the first scientist to indulge in the pastime of constructing elaborate genealogical trees of the species, and to talk about man as the "topmost twig;" while it was in one of Haeckel's talks that *Pithecanthropus* achieved the position of the specific connecting link between man and the anthropoids.

From the very first Haeckel's philosophy was—shall we say disfigured?—by the grossest materialism. He was convinced that there was no essential line of cleavage between organic and inorganic nature, other than the defining statement that the former consists of the carbon compounds. In the concrete properties of the carbon atom, as developed in the complex albuminoid compounds, he saw the one and only cause of the specific phenomenon of movement which characterizes organic substances. He thus reduced life to a chemical and mechanical basis, asserting that the first living protoplasm arose from such nitrocarbons by a wholly spontaneous process not fundamentally different from any other chemical reaction. Psychology he therefore regarded as merely a branch of physiology; and he traced the human mind back to the unicelluiar origin, from which he conceived it to have evolved by processes identical with those giving its present form to the body also. And of course he was forced then to repudiate personal immortality and the freedom of the will; for him there could exist no soul and no moral order of any description.

Haeckel really championed the cause of evolution so enthusiastically because these other things which he wished to believe seemed to him to be necessary consequences of it. He quite overlooked the fact that in drawing such conclusions from the evolution hypotheses, it was necessary to make tacit assumptions which required further support. We need not quarrel seriously with him here, however; for his support of the new biology was worth having at any price.

Haeckel himself was quite ready to carry the thing as far as it would go, and he frankly elevates his science to the level of a religion. He must have realized that the difficulty of avoiding such conclusions made the most potent argument for discrediting the whole structure of evolution; but he was the last man to bend his own convictions to meet the inherent tendency of humans to postulate a future existence. Perhaps history will hold that his greatest shortcoming was his failure to realize that reconciliation between science and religion was both possible and desirable.

Back to the Land

California Pioneers the State Land Settlement Plan

By H. A. Crafts

TODAY California goes on record as the pioneer in land settlement; in other words, the patron of State-aided agriculture. For the year 1918 saw California's first land settlement fully organized, and in successful operation.

The enterprise was authorized by a State law, approved June 1, 1917. Section one of this act sets forth that, "The Legislature believes that land settlement is a problem of great importance to the welfare of all the people of the State of California, and for that reason, through this particular act, endeavors to improve the general economic and social conditions of agricultural settlers within the State, and of the people of the State in general."

The act created a State Land Settlement Board of five members. At the head of this board is Professor Edward Mead, the well-known irrigation expert, and agricultural economist.

To finance the land settlement scheme an appropriation of $250,000 was made; and the board, acting upon its authority, purchased 6,480 acres of land in Butte County. All but about 1,000 acres of this is alluvial river bottom land and very rich in its character.

The first allotment to settlers was made in May, 1918, and the second in December. The first allotment covered 3,520 acres, and was allotted in 53 farms, 44 of which were taken. The average cash capital of these settlers was $3,000; their average assets, including live stock, farm implements, household furniture, etc., was about $7,000.

At the same time 21 farm-laborer's allotments were made, of two acres each, the limit of area to this class of settlers. The average capital of these laborers was about $1,200.

The act of legislature above cited specifies that purchases of land may be made by a single settler up to $15,000 in maximum value. The settler is required to pay only 5 per cent of the purchase price of his land in cash; the balance due to run in amortized payments for a term not to exceed forty years at five per cent interest. The settler upon this land agrees, under penalty of the forfeiture of his rights granted by the contract of purchase, to cultivate the land in a manner approved by the State Land Settlement Board; to keep in good order and repair all buildings, fences and other permanent improvements on his allotment. The farm laborers are permitted to purchase their allotments upon similar terms and conditions.

The economic policy of the board will be the adoption of a system of general, rather than specialized farming, with a decided leaning towards the production of elemental food stuffs, with due regard to live stock interests.

It is planned by the board to encourage the use of pure-bred live stock, and this, as far as possible, of a single breed, in the interest of uniformity in the process of production; and these breeds to be only of the best types. The board, itself, will own some of the best bulls obtainable, furnishing their services to the settlers at mere cost, and changing the individuals every two years.

In neat cattle the Holstein has been chosen by the board as the best strain for the purposes of the settlement. In swine the Duroc-Jerseys have been selected. Settlers are permitted to purchase their pure-bred cows through the board, in order to be insured against inferior stock. Efforts will be made to induce every settler to keep a small flock of sheep of the best breeds, for both wool and mutton combined.

In spirit and substance it will be the endeavor to establish a farm community for the production largely of meat, dairy products, poultry, eggs, etc., thus helping to augment the State's substantial food supply in a practical manner.

The board has already expended nearly $100,000 on improvements, such as roads, drains, irrigating ditches, fencing, etc.

The board employs regularly a farmstead engineer, whose services are contributed, free of charge, to the use of the settlers. This individual lends his assistance to the planning of farm houses, outhouses, barns, fences, and the proper location of the same with reference to the farmstead.

The board also renders valuable assistance to the settlers by taking the onus of building contracts upon itself, thus securing to the settler the best quality of service at lowest prices. This arrangement extends to the building of fences, digging wells, excavating irrigation ditches, laying drains, etc. As an example of this arrangement may be cited the fact that at one time during last summer the board was digging some seventeen wells for as many different settlers.

This tract of land when purchased carried valuable irrigation water rights with it; and since that time additional water rights of the same class have been purchased by the board and turned over to the use of the settlers, so that ample water rights are had for all irrigable lands.

Two main highways extend through the settlement, one maintained by the board and the other by Butte County. Cross roads have also been constructed, so that each farm faces upon a public highway.

It is planned that each farm shall produce at least $3,000 worth of products each year, in the gross.

The idea of farm labor allotments originated with Prof. Mead, who has made a personal investigation of the subject in Australia, where the land settlement system has been in successful operation for quite a number of years. Under this system the laborer may remain such, or become a proprietary farmer, as he may himself elect. He is also permitted to find employment in the settlement, or in the surrounding neighborhood. The point is to help farm laborers to become experts at their trade, and at the same time possess neat and comfortable homes; also to fit themselves for the earning of the highest rate of wages in their class.

On his own allotment the farm laborer is required to cultivate all of his two acres excepting that portion needed for building sites; and to keep his grounds and building in good condition and repair.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Another Way to Save the Wool

To the EDITOR OF THE SCIENTIFIC AMERICAN:

One of your correspondents suggested that money could be saved by making the legs of stockings of cotton and the feet wool, and some manufacturers took the hint.

Summer stockings should have no leg at all. Save the money paid for leg and garter for something sensible, and because the nearer one comes to going naked in summer the better for his health and comfort.

I don't believe that either the chains of habit or the bonds of prudery would long prevent all mothers from purchasing—for children at least—short-leg stockings if they were put on sale.

S. N. STEWART.

Dayton, Ohio.

An Analogy that Displeases

To the EDITOR OF THE SCIENTIFIC AMERICAN:

In regard to the article "The Industrial Democracy," on page 52 of Scientific American of July 19th, I would like to point out that the supposed analogy between political and industrial democracy is wholly misleading. In matters of *State* policy we all have, broadly speaking, the same interests at stake, and hence we are all equitably entitled to equal share of State control.

In an *industrial* concern the case is totally different. The owner has his fortunes and reputation at stake—failure brings ruin to him. The workman has nothing at stake, and suffers nothing more than the necessity changing his place of employment,—and that he frequently does from choice.

As for sharing profits, where there is no corresponding sharing of the owner's risks, responsibilities, and losses, that is paternal generosity, pure and simple, and has no basis in business, equity, or democracy.

EDWARD COLLINS.

Washington, D. C.

Why Does a Crankcase Breathe?

To the Editor of the SCIENTIFIC AMERICAN:

Your issue of June 28th contained a very interesting article with the above title. Permit me to add a few remarks which, it would seem, were overlooked, at least from a practical standpoint.

It is shown that there is an alternate state of compression and partial vacuum in the crank case, due to the varying speed and movements of the pistons.

The first paragraph of the article states that were no breather provided, the result of this pressure and vacuum would be to force oil out through the bearings and then draw it back along with dust and foreign matter. Theoretically this would be true; but there is another factor to be considered and (assuming that no breather were provided), tends to produce very different results.

It is a generally known fact that there is almost invariably a leakage of gas past the pistons on the compression and power strokes. This leakage may be slight or it may be considerable, depending on piston clearance, efficiency of oil, piston rings, etc. In any case the obvious result is that this leakage will form a state of constant pressure in the crankcase and continually force oil out through the bearings and any joints not perfectly tight. In extreme cases it might tend to produce over oiling by forcing oil past pistons on inlet or suction stroke, at which time there would be a vacuum above the piston and pressure below.

By providing a breather these difficulties are reduced to a negligible point; the leakage of gas which would otherwise maintain a state of pressure in the crankcase being expelled through the breather. It will be noted that the quantity of air "exhaled" each time is slightly more than that "inhaled."

This I believe, quite covers the subject, "Why Does a Crankcase Breathe?"

STANLEY F. MICHAELS.

Lockport, Ill.

Clouds Formed by Airplanes

To the Editor of the SCIENTIFIC AMERICAN:

Referring to communication on the above subject from Everett D. Wells, in SCIENTIFIC AMERICAN of June 7th, 1919:

A similar phenomenon on smaller scale has recently been discovered and utilized in the Army high-speed wind tunnel by F. W. Caldwell, C. P. Grimes, and the writer. When the relative humidity is proper, a small model aerofoil held in the air current induces moisture condensation, with the result that the flight vortices are clearly seen, can be analyzed and photographed.

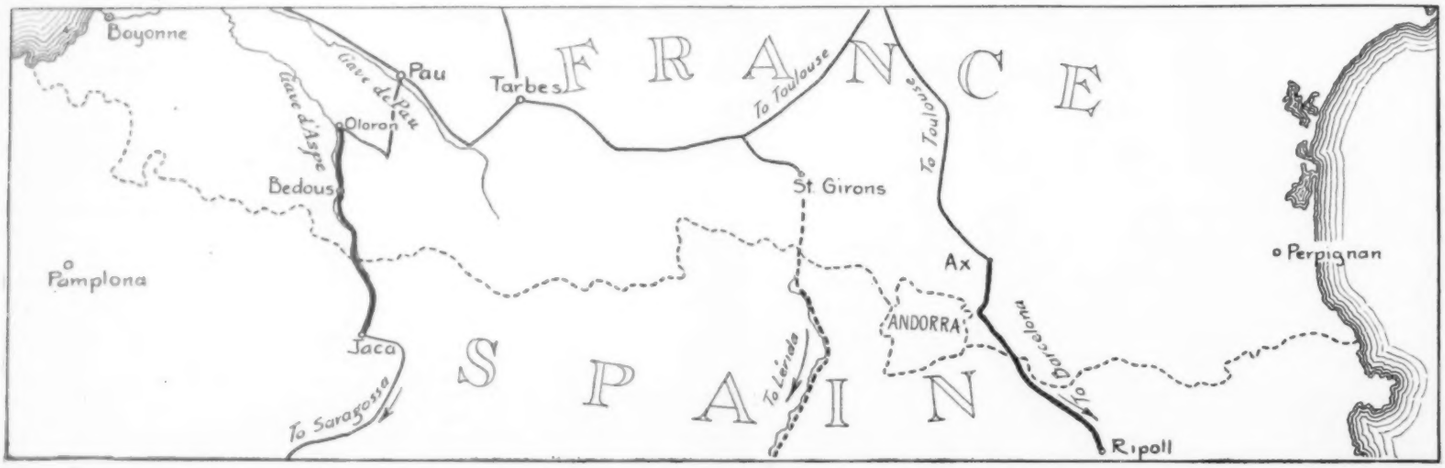
The effect in full scale could well appear as described in Mr. Wells' note; the vortex characteristics being indistinguishable to the distant observer. It can be inferred that the ribbon of cloud, as stretched across the line of vision, had a wedge-shaped front, the wedge-angle being less than 10 degrees. The upper limb of the angle then constituted a tip-vortex rotating about an axis extending from each wing tip toward the rear. A cross-section of the cloud taken 200 feet behind the airplane would not show up as a solid rectangle, but as a wide, flat-bottomed "U." At great distances behind the airplane, the vortex energy would be dissipated and there would remain quiescent cloud.

Photographs of the cloud described would be of interest; in the wind tunnel, where the wind moves against a fixed model, stroboscopic methods are necessary for observation of the periodic run of flight vortices. In the case described by Mr. Wells, however, the periodicity would be expected to appear in billow-formation.

A method of observation peculiarly suited to study of the aerodynamics of airplane flight depends upon the fact that after the dew-point is reached, a solid or liquid nucleus is necessary before condensation takes place. Other methods, such as the use of smoke, lycopodium powder, etc., were tried in their most advanced forms, but proved inferior. The dew-point method has made possible for the first time, so far as the writer knows, the direct visualization and mensuration of the vortex phenomena of flight.

ELISHA N. FALES.

Dayton, Ohio.



Map of Franco-Spanish border, showing by heavy lines the two international routes under construction, and by a broken line the projected route from St. Girons to Lérida

Piercing the Mountain Barrier Between France and Spain

Two Difficult Pieces of Railroad Engineering Now Being Projected Through the Heart of the Pyrenees

By F. Honoré, Paris Correspondent of the Scientific American

THE piercing of the Pyrenees is achieved, and if the work had not been delayed by the war, trains would already be running in the tunnels connecting France and Spain. This enterprise, which once more testifies to the skill of the French engineers, presented serious difficulties; but these have been met with complete success, as we shall show.

The chain of the Pyrenees extends over a length of more than 600 miles as the crow flies, from the east to the west in France and Spain. At the east, it debouches into the Mediterranean, on the west, it runs out into the Atlantic. That part of the chain which constitutes the Franco-Spanish boundary measures 250 miles in a straight line, and the peaks vary in altitude from 2,950 to 11,150 feet.

Only two lines of rail connect France and Spain; these are the two coastal lines that in this way manage to run around the mountains. The one on the Mediterranean end is the line from Narbonne to Barcelona via Cerbère and Portbou; the other follows the shore of the ocean, running from Paris to Madrid via Hendays, Irun and San Sebastian. These two lines are 250 miles apart, and throughout this interval a few mountain roads are all that maintain (in very insufficient fashion) the connection between the two countries.

Since 1853 the French engineers have had in mind the crossing of the central Pyrenees by a railroad, but it was not until January, 1907, that a convention was definitely approved between France and Spain for the construction, within a period of ten years, of the following international lines:

1. From Ax-les-Thermes to Ripoll, shortening by 65 miles the distance from Toulouse to Barcelona.

2. From Oloron to Jaca and Zuera, shortening by 15 miles the route from Paris to Madrid, and by 44 miles that from Paris to Saragossa. These savings of distance will be increased to 70 and 100 miles, respectively, by the completion of the cut-offs from Pau to Hagetmann and from Langon to Libourne. However, by reason of the grade of these latter sections the saving of time will be slight.

Outside these two lines, which are located respectively toward the east and the west of the mountain chain, a third has been looked forward to, connecting St. Girons with Lerida. But France is not expected to begin work on this until Spain has completed the line from Lérida to Sort, and this condition has not yet been realized.

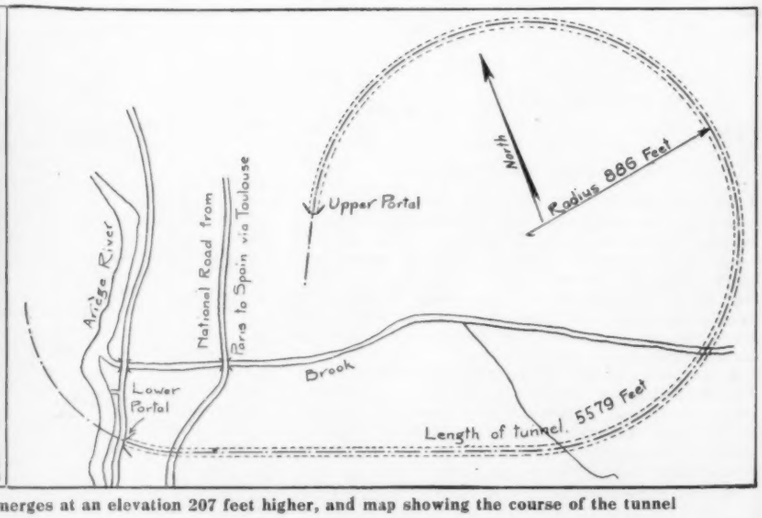
Ax-les-Thermes to Ripoll

This line at times winds about at the foot of rock walls so steep that, to make the topographical maps, the engineers had to be lowered on cables attached to steel bars embedded in the rock. The line is of a single track, and starts from Ax-les-Thermes, a pretty little place where one sees water running from the hot springs in the streets at a temperature of 185 degrees Fahrenheit, and which lies 2,300 feet above sea-level. The route passes through the wild gorge of the Ariège, running along the edge of the river. This it bridges in four places which have been so chosen as to avoid the paths of avalanches that are very frequent in this region. On the way to the gorge and then along it, we may count ten tunnels ranging from 130 to 5,580 feet in length, four viaducts of from 98 to 148 foot span, and a large number of bridges of from 30 to 65 feet in length. The longest tunnel in the gorge is in the form of a spiral; this means is employed of effecting a climb of 207 feet at a point where the slope of the valley floor increases sharply from four to nine per cent, and where the walls are altogether too steep to permit of a zig-zag ascent.

The great tunnel at the highest point of the line passes beneath the Puymorens divide, which separates the Atlantic and the Mediterranean water-sheds. It is 17,566 feet long, with a grade of 3.4 per cent from the north portal to the summit, and of only 0.3 per cent from the south portal to the summit. These two inclines are joined by a level "stair-head," as the French call it, three hundred feet in length. The entrance to the tunnel from the north is made at an altitude of 4,747 feet, while the southerly exit is 5,177 feet above the sea—that is to say, 2,877 feet higher than the starting point of the line, which has an altitude of 2,300 feet. The pass itself is 6,293 feet above sea-level, so that the minimum thickness of the rock covering of the tunnel is about 1,100 feet.

The line then descends again into the valley of the Carol, where it passes over three viaducts of 217, 148, and 433 foot span. The international station of Latour de Carol is on French territory.

The cost of the undertaking was estimated before the war at 31 million francs. The construction of the Puymorens tunnel, the most delicate part of the work, was entrusted to the French engineer, Bartissol, who built on the ground an electric station of 1,000 horsepower, using a water fall of 1,300 feet. The traction in the tunnel is electric. Excavation was conducted from both portals by means of compressed-air drills run by



Where the great spiral bore of Saillans plunges into the mountain and emerges at an elevation 207 feet higher, and map showing the course of the tunnel

the same current that will later operate the trains. Part of the bore lay through hard granite in which the tunnel was left without special lining, part was through slaty schist. The flow of water was nowhere greater than seven gallons per second.

Tunnelling was begun in October, 1909. The two headings met on November 24, 1914, with the customary precision. The daily advance, working two ten-hour shifts, was about 13 feet of the gross cross-section of the tunnel.

Line from Oloron to Zuera

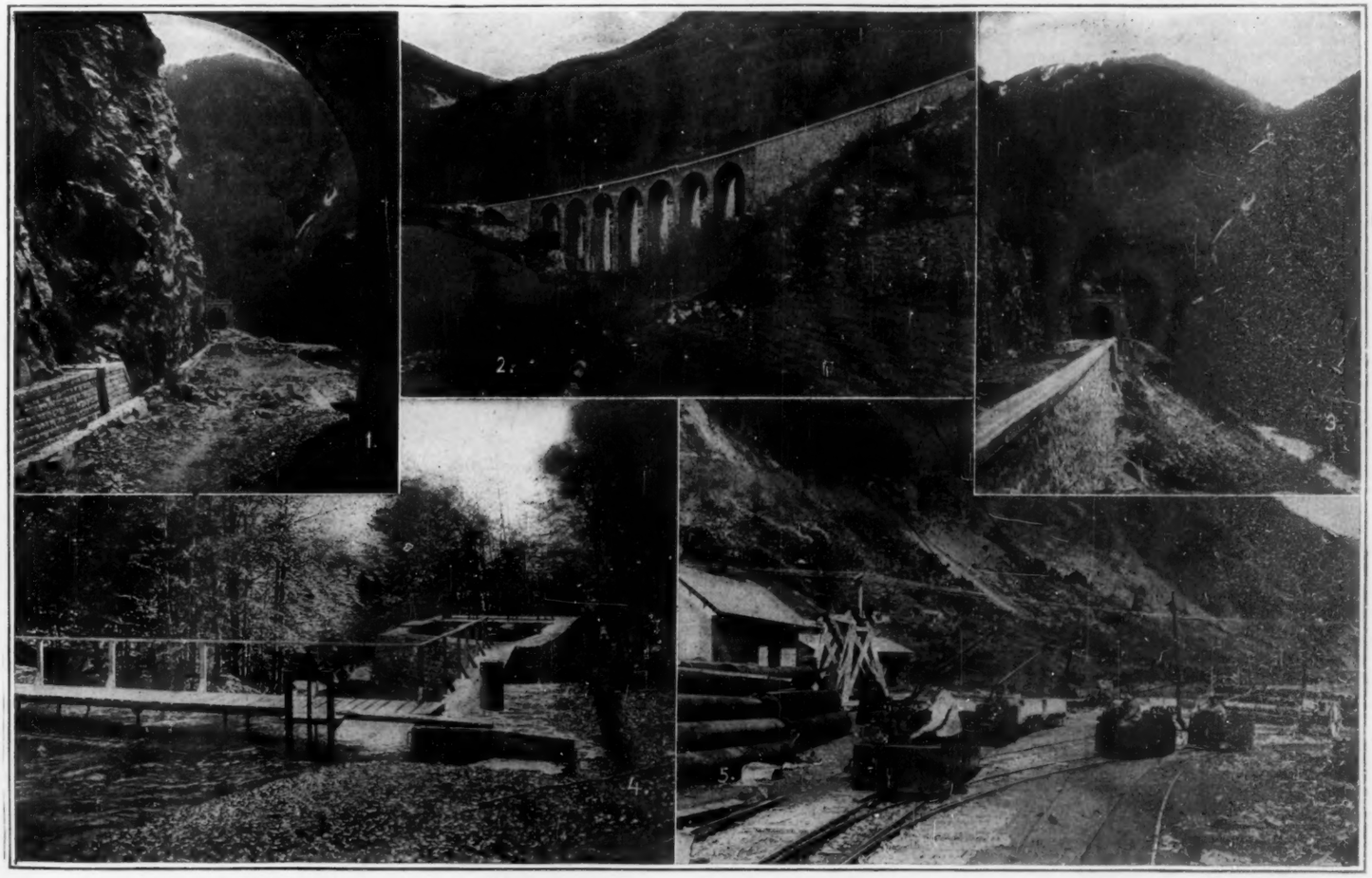
This line comprises a first section of 15 miles from Oloron to Bedous, terminal point of the line from Pau. The second section runs from Bedous (France) to Aranones (Spain); this is 19 miles in length and crosses the summit of the Pyrenees beneath the Somport pass (1,020 feet high). This is also known as Port d'Urdos, being defended by a very picturesque old French fort. It was over this route that Abder-Raman passed in 732 with his redoubtable army in menace of Christendom.

The route runs through the pretty gorge of the Gave d'Aspe, which it crosses four times. It rises from an elevation of 1,345 feet at the beginning to 3,566 at the end, traversing 14 tunnels of which the longest is 5,823 feet long. The latter is also in spiral and permits the road to rise nearly 200 feet without advancing up the valley. There are in this section four viaducts and eight bridges and the grade runs as high as 4.3 per cent.

The international tunnel has a total length of 25,860 feet of which 13,163 feet lies under French territory with a grade of 3.4 per cent, and the remainder is in Spain with a grade of .43 per cent. The French portal is at an elevation of 3,566 feet, the Spanish at 3,947 feet; the bore passes at a depth of 2,526 feet below the peak of Tobasso. The international station is at Los Aranone, on Spanish territory. Continuing south from here, the road penetrates into the valley of the Aragon, and passes via Jaca to Zuera on the line from Saragossa to Barcelona.

The construction of the international tunnel was carried out by the French contractors, MM. Desplats and Lillaz, who performed their task very well, although surrounded with great difficulties. In this absolutely desolate region it was necessary to create a city with school, stores and police; to organize between Oloron and the portal of the tunnel, a distance of 30 miles, a service of transport for horse carts or ox carts, for auto trucks and for steam tractors, for sledges and for mule teams; to install a hydroelectric plant of 600 horse-power; finally, to fabricate the concrete blocks for the masonry of the tunnel. It was necessary to maintain an average daily advance of about twenty feet to complete the tunnel in the scheduled period of four years. The French end of base gallery was driven to its end on September 30, 1912. All measures had been taken to make possible the completion of the work during 1918. If the war had not held up the work altogether, in some parts, it greatly delayed it through the mobilization of many of the workers; and in other sections the project had to be suspended entirely. Since the armistice, it has been found necessary to modify all the contracts and the closed sections have seen work recommenced.

It is hoped that the lines can be ready for use toward the end of 1922, which will mean that the total delay will exactly equal the duration of the war. The passage from France to Spain by either of these routes will offer the traveller a series of admirable views where the very special charm of the Pyrenees alternate with aspects of grandeur which are familiar in the wildest parts of the Alps.



1. Tunnel after tunnel in the region of Berduquet" 2. One of the numerous viaducts. 3. View along the wild gorge of the Ariège. 4. Leaf trap to keep the culverts from choking with leaves and other vegetation carried down by mountain torrents. 5. Electric locomotives used in hauling construction materials.

Picturesque scenes along the line from Ax to Ripoll, in the Pyrenees which separate France from Spain

Seventy Miles Per Hour with a Seven-car Train

EASTBOUND express train No. 4, of the New York Central, on Sunday, May 14th, being more than an hour behind time, traversed the division from Elkhart, Ind., to Toledo, Ohio, 133.01 miles, in one hour, 54 minutes, or at the rate of 70 miles an hour. From Millersburg, Ind., 18 miles east of Elkhart, to Nasby Tower, about 4 miles short of Toledo, a distance of 111.31 miles, the time was one hour, 27 minutes, equal to 76.76 miles an hour, continues *Railway Age Gazette*.

The train, in charge of Conductor Cantrick, consisted of 7 steel cars, weighing about 940,900 pounds. The engine, No. 4853, weighs, with its tender, about 250 tons, and it was run by H. Evans. The weather was clear.

This division of the New York Central, is as nearly straight and level, probably, as any road of equal length and importance in the United States, there being one tangent about seventy miles long.

Railroads were crossed at Goshen, Kendallville, Waterloo, Butler, Bryan and Wauseon; at the crossing two miles east of Wauseon, and at Nasby Tower. Water was taken from track pans at Grismore, east of Millersburg; at Corunna, and at Stryker, about seven miles east of Bryan.

The principal significance of this record of speed is in the weight of the cars. Equally good time was made over this division, westbound, by the Twentieth Century Limited, sixteen years ago (May 25th, 1903), but that train had only four cars. On June 8th, 1905, a train of the Pennsylvania Lines, Western division, No. 18, east bound, second section, three cars, was run 50 miles at 79 miles an hour; 100 miles at 77.2 miles an hour; and 200 miles, including two stops, at 71.3 miles an hour. On October 24th of the same year, a Pennsylvania special train of four cars, westbound, weighing 260 tons, was run from Crestline, Ohio, to Clarke Junction, Indiana, 257.4 miles, at 74.55 miles an hour. In this run a distance of 131 miles was covered at 77.81 miles an hour.

Chance for Inventors

THE Small Arms Division, Ordnance Department, U. S. A., invites inventors to submit designs of semi-automatic shoulder rifles, in accordance with recent specifications prepared which outline requirements such arm should possess in order to be acceptable as a service weapon. Copies of these specifications may be obtained by application to the Chief of the Small Arms Division, 6th and B Streets, Washington, D. C.

Our Technical Achievements in the Great War—IV

Providing and Forwarding Food, Clothing and Equipment for Our Armies

DOUBTLESS many people, at various times during the war, asked themselves why it was that the equipping of our armies called for such enormous supplies as to strain some of our manufacturing industries almost to the breaking point. The answer to that question will be found in the facts assembled in the present chapter.

In the first place, most civilians made the mistake of supposing that the problem of supplying the necessities of life for the young soldiers in our Army was the comparatively simple one of diverting into the camps substantially the same amounts of food and clothing as these young men would have used in their homes if there had been no war. Our army represented one twenty-fifth of our population, and because of the robust quality of these young men undoubtedly, before the war, they consumed more than one twenty-fifth of the food and clothing. But this allowance and every other allowance that can be made for the requirements of youth and the wastefulness of war, fail to explain the enormous excess of army purchases above those of civilian life in times of peace. These differences are shown in the accompanying diagram, which compares the total production of blankets, wool gloves, wool socks and men's shoes in 1914, with army purchases of the same articles in 1918. The comparison shows that army purchases in 1918 of blankets were two and one-quarter times as great as the entire American production in 1914, which means that the blankets bought in one year for four or five million soldiers were equal to the normal consumption of blankets by one hundred million American civilians for two and one-quarter years.

The explanations of these enormous purchases are simple and conclusive. First, the men who went to camp received complete equipment of new articles; whereas production in peace time served mainly to replace articles that have been worn out. Secondly, supplies for an army increase in proportion to the distance of that army from its home base. Thirdly, the consumption of an army in action is three or four times the peace rate. With an army three or four thousand miles from its sources of supply, the amounts of supplies in reserve and in transit are enormous as compared with the quantities actually consumed each month. The rule followed for clothing was to have for each man at the front a three months' reserve in France, another two or three months' reserve in the United States, and a third three months' supply continuously in transit.

As an example of how this rule operated let us take wool coats, which lasted about three months in active service. For every coat on a man's back at the front there had to be a coat in reserve in France, a coat in transit, and a coat in reserve in the United States. Thus for every man at the front, four coats were needed, and needed just as soon as he went overseas. Two million men overseas required about 8,000,000 coats and required them immediately.

"The same thing," says Colonel Ayres in his statistical summary, "was true for other supplies and munitions. For munitions difficult to manufacture, such as artillery and ammunition, the problem presented by this necessity for reserves and large amounts in transit, in addition to the actual equipment of troops, was almost insuperable." We shall deal with the munitions problem in a later chapter.

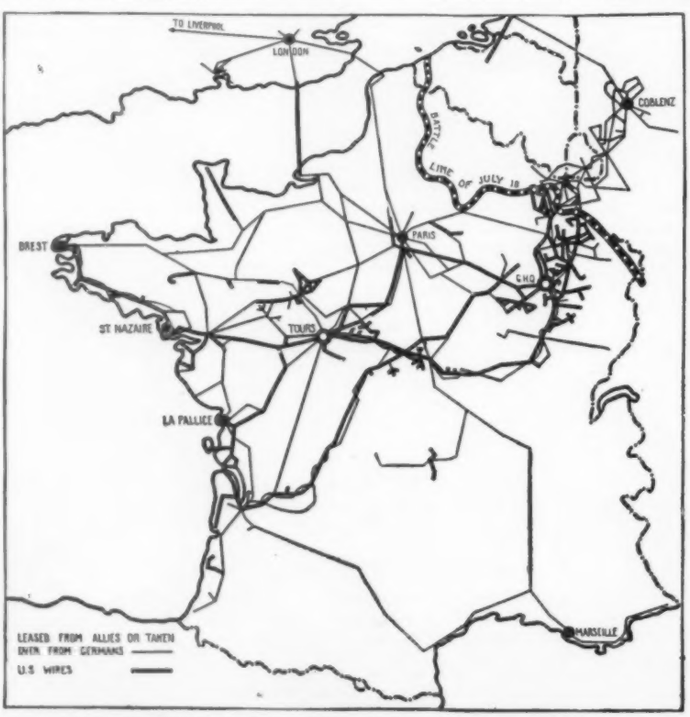
A list of the total deliveries during the war of some of the common articles of clothing shows the magnitude of the task; and we give herewith a table of total deliveries, the cost of the articles listed being over one billion dollars.

Cloth delivered to the Army April 6, 1917 to May 31, 1918

Articles	Total Delivered
Wool stockings ..... pairs	131,800,000
Undershirts	85,000,000
Underdrawers	83,600,000
Shoes ..... pairs	30,700,000
Flannel shirts	26,500,000

Seaports, storage plants, and supply lines of the American army in France

Articles	Total Delivered
Blankets	21,700,000
Wool breeches	21,700,000
Wool coats	13,900,000
Overcoats	8,300,000



American telegraph and telephone lines in France, England and Germany

To secure these and other articles in sufficient quantity, the army in many cases had to take control of all stages of the manufacturing process, from assembling the raw material to inspecting the finished product; and for many months preceding the armistice the War Department was owner of all the wool in the country. Had the troop movement continued the army needs from September, 1918, to June, 1919, were estimated at 246,000,000 pounds of clean wool, while the amount allotted to civilian needs was only 15,000,000 pounds. A story of somewhat the same kind might be told for about thirty thousand kinds of commercial articles which the army purchased.

How the Vast Army Supplies Were Distributed

The problem of distributing the army supplies and equipment was in many respects as difficult as that of their procurement. For distribution a new organization was necessary. This problem in America was not difficult because of our ample railway facilities. Furthermore abundance of motor transportation was available and the troops were near the sources of supply. In France, however, the army had to create an entirely new organization, known as the Service of Supply, which had its headquarters at Tours, which is located well in the center of France. How great a system this was is shown by the fact that on the day of the armistice 386,000 soldiers, 31,000 German prisoners and thousands of civilian laborers furnished by the Allies were reporting to the Commanding General of the Services of Supply. In addition, there were 160,000 non-combatant troops in the zone of our army, most of whom were maintaining in operation the lines of distribution of supplies to the troops at the front. Hence it will be understood that the proportion of non-combatants in the army never fell below 28 per cent. In the British Army it often ran higher than that.

The task of distributing supplies to the American Forces in France included four problems. First, that of seaports; second, that of railroads; third, that of motor and horse-drawn transportation, and lastly the problem of storage.

It was not necessary to build new ports; the American engineers added in existing ones eighty-three new berths, together with the necessary warehouses and dock equipment. Nor was it necessary to build new railways. The French system is denser per square mile than that of the United States. What was done to increase the carrying capacity was the building nearly one thousand miles of new trackage, the providing of additional switching facilities, the erecting of new repair shops and round-houses and providing new rolling stock. All these things were done by the Engineers, and the results were that the capacity for handling American cargo was tripled from 10,000 tons per day in the spring of 1918 to 30,000 tons by November 11. The accompanying map shows the main railway line used by our overseas forces.

Narrow-Gage Railways and Motor Trucks

The American supplies were carried by the main railroads from the port in France to intermediate or advanced depots. The railways roughly paralleled the front, and spurs led up to the front, but only to within a certain distance of it. Where they came under shell-fire, or the front was rapidly changing, the place of the broad-gage railway was taken by other means of distribution. First, the narrow-gage railroad, with rails two feet apart. Our engineers built 538 miles of these roads. Where the narrow gage railways stopped, the motor truck took up the service. The number of

trucks sent overseas prior to the armistice was 40,000, and 33,000 ranging from three-quarters of a ton to five tons had been received in France. Beyond the range of the motor truck, dependence was placed upon the horse and wagon for distribution of supplies.

Speaking of the question of transportation Colonel Ayres says, "In general, the army overseas never had enough of transportation. It may also be said that they had very large quantities and they produced remarkable results with the supply they had."

47,000 Telegrams a Day

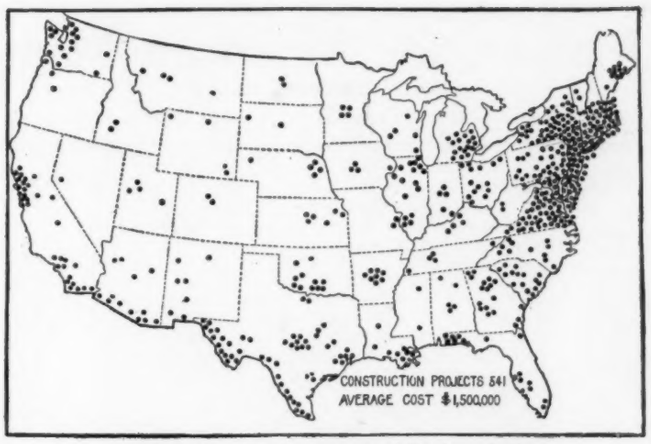
Not less interesting than the map showing our storage and railway system in France is the one which shows the location of the American telephone and telegraph lines in France, England and Germany. To operate the transportation of supplies it was necessary to set up a new system of communication in France; and the Signal Corps strung its wires practically over the whole country. The heavy lines on the map indicate telephone and telegraph lines wholly constructed by American wires strung on French poles. The light lines show wires leased from the French or taken over from the Germans, these latter being the lines taken over by our Army of Occupation. On November 11 the Signal Corps was operating 382 telephone exchanges and 133 complete telegraph stations. There were 14,956 telephone lines reaching 8,959 stations. At the height of its operation our telegraph system handled 47,555 telegrams a day, averaging sixty words each.

Construction Work for the Army in the United States

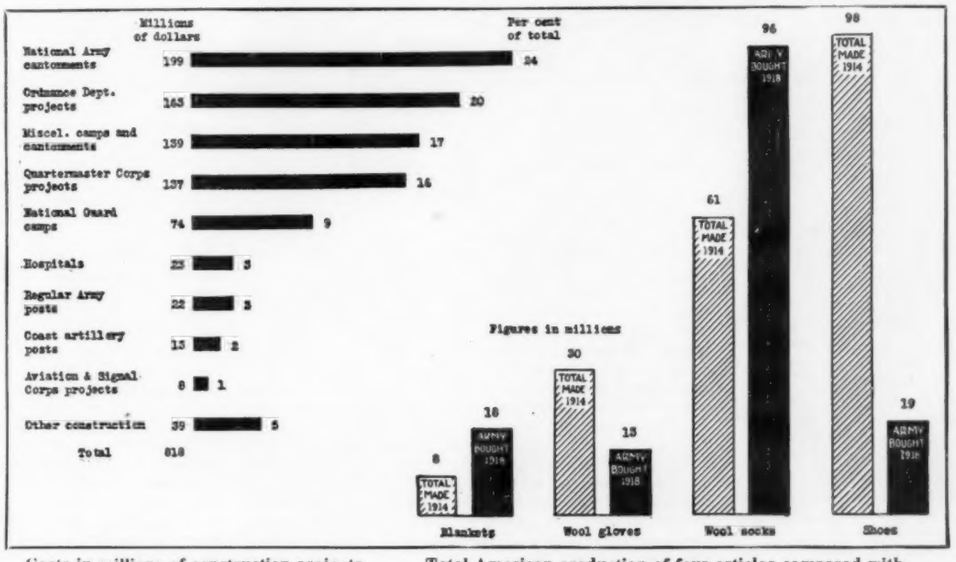
Workmen to the number of two hundred thousand were continuously occupied during the war in building factories and storage warehouses in the United States. The constructions included cement piers and warehouses, proving ground equipment, powder and explosives plants, repair shops, roads and housing for troops. These activities covered every State in the Union as shown in the accompanying map, where each dot represents a construction project. The region of greatest activity was the northeast, the center of munitions production.

The housing construction had a capacity of 1,800,000 men, and the total expenditures equalled $800,000,000 or twice the cost of the Panama Canal. The most re-

(Continued on page 194)



Location of construction projects of the Army in the United States



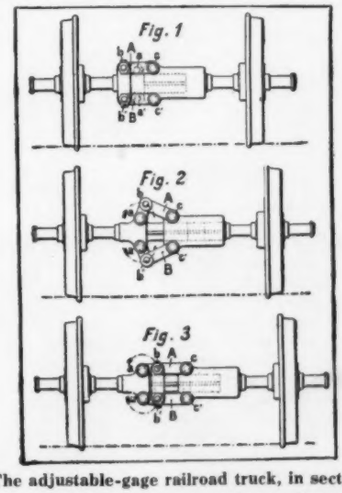
Costs in millions of construction projects in the United States

Total American production of four articles compared with Army purchases

Carwheels That Fit All Gages

THE rail was laid for cars to run over in the first place for the sake of the improved traction which was thus got. A necessary inconvenience which went with the attainment of this advantage was that cars could travel only on tracks whose gage was precisely equal to the distance between their wheels—or to put it another way around so that the statement will correspond more closely to the point of view of the first railroaders, that all rolling stock in use on a given line must be specially manufactured with a given distance from wheel to wheel. Built for a track of the given width, cars and locomotives have never been susceptible of adaptation to a line of different width, without a complete rebuilding which would make them in turn equivalent to cars built for track of the new width. So rigid has the system been that the Russian military thought it was effecting an absolute safeguard against foreign invasion by causing the Russian railroads to be laid down with a gage different from that used anywhere else in Europe.

It has seemed always quite obvious that there was no remedy for this. The wheel must sit firmly upon the axle, so that the pressure of the wheel cannot by any possibility force it off its seat and derail the car; while at the same time the suspension must be such as to permit the freest rotation at any speed whatever. To ask that a third demand of axle extensibility be incorporated, so that the truck may be quickly shifted from one gage to another, seems certainly to be too severe a piling up of complications. Yet this is precisely what a French inventor, N. L. Rupin, has apparently succeeded in doing. More than this, his system is so designed that no manipulation whatever is necessary in leaving a broad gage for a narrow one or vice versa; the axles and wheel suspension are so arranged that the distance between wheels automatically adjusts itself, in passing from one gage to another, in such a way as always to fit the gage of the rails.



The adjustable-gage railroad truck, in section

Fig. 1 shows the two semi-axles brought together to the limit of their capacity, for the narrowest gage that can be traversed; the connecting rods A, B, articulated in a, b, c, a′, b′, c′, are then folded into the shortest possible compass. In Fig. 2, the semi-axles are lengthened by an intermediate amount and in Fig. 3, the connecting rods appear extended to their limit to permit the use of the maximum gage.

In its simplest terms the solution of course consists in extensible axles. To go a little further into the means of extension, we find that the wheel suspension is by special platforms, installed laterally beneath a central "chassis" which is attached to the underbody of the car. Each axle is in reality formed of two semi-axles connected at the center by a special arrangement enabling the system to be telescoped by a distance which is limited by a set of connecting rods. A flat longitudinal key-piece, lodged in a groove which is provided in the parts of the axle that slide upon one another, guides the two members in extension, and at the same time prevents all torsional or eccentric movements out of the planes of rotation of the wheels.

When the car is about to pass from a track of one gage to, say, a narrower one, the passage is effected by running the car over a section of track of uniformly diminishing gage joining the two main sections in question. The rails of this tapering section are equipped with counter rails both interior and exterior, which apply pressure to the outer and inner faces of the wheel flange, respectively. This pressure of the counter rails is transmitted by pivots or pins to the suspension platforms, which track on short rails or in short channels laid across the underbody of the car; so these platforms are forced in toward the central common point of suspension of the two semi-axles. The tapering section of track is of sufficiently gentle inward slope so that the slight departure from parallelism between its rails and the flanges introduces no torsional strains of any notable extent. To pass from a narrow gage to a broader one, since the guide rails are laid on both sides of the transitional track, the process is simply reversed. It is insisted that a construction has been provided which will respond to the pressure of these counter rails, but which is sufficiently stiff to refuse to respond to accidental jars and jolts. Of course this is a necessary condition, otherwise the train would be ditched at every bump.

Delivering Mail to Steamer After It Has Sailed

ONE of the contemplated uses of the airplane in peace time is that of overtaking steamers at sea for the purpose of placing delayed mail aboard. Obviously, the speed of the average airplane makes it possible to overtake a steamer several hours after it has left the port, thereby extending the mail service time that many hours.

An experiment in delivering mail to a steamer is to be undertaken within a few days by C. J. Zimmerman, a skilled pilot, who will follow the steamer "Adriatic" two or three hours after she has sailed for England, and overtaking her will drop a mail pouch with a wooden float attachment into the sea just ahead of her bow. This experiment will be closely followed by the postoffice authorities and the steamship men, in order to determine the practicability of the scheme.

It has also been suggested that steamers might carry small airplanes which, when the steamer neared port, might fly with bags of mail. If airplanes were employed to overtake the steamer, and one or more airplanes employed to make port some hours before the steamer, perhaps eight hours or more might be saved in trans-Atlantic mail service. However, such a scheme would call for a considerable number of machines and pilots, and would entail a notable expense.

World Markets for American Manufactures

Edited by LYNN W. MEEKINS

A department devoted to the extension of American trade in foreign lands

The Through Bill of Lading in Foreign Trade

To the Editor of the SCIENTIFIC AMERICAN:

I HAVE before me a copy of your publication dated August 10th, 1918. It has been sent to me, with the article, "A Necessary Document in Foreign Trade." My experience with the Combined Railroad and Steamship Bill of Lading has been such that I can readily understand some of my customers' having dropped across the article and sent it to me for perusal. I appreciate that there are two sides to every question, and that from the point of view of the seller the through bill may look like a good thing. But when your article seemed to hint that your Government was going to do away with it, I must confess I threw my hat in the air.

May I give some of my experiences in support of my contention that of all the objectionable documents transmitted to this country by exporters of American and Canadian goods and products, this combined bill of lading takes first place? Prior to the war the use of such a document was not general; but since 1914 it has been rather the rule than the exception. The discontent amongst importers of American goods is so grievous that a petition was made in 1916 to your Commercial Attaché in Melbourne to have the matter brought before the proper American authorities with a view to discontinuance of the document in question. The assumption is that manufacturers in America, particularly those far from the coast, are unaware of the serious lack of knowledge of overseas trade requirements which they exhibit when they attach a totally incomplete bill of lading to their drafts on Australian buyers or on Australian credits in America. An occasional transaction of such character might be overlooked, but the practice has become so common that Australian merchants are refusing to accept drafts accompanied by the combined bill of lading, and are instructing their agents in America not to negotiate drafts against established credits unless they are backed by a clean steamer bill. The combined draft is not a negotiable document because it gives no assurance when the goods will come to hand; it is not a receipt from the steamship company—the goods so invoiced may come forward in several vessels, months apart, causing endless annoyance at the port of discharge; and if they never come we are not at all sure that we have any practicable redress.

I attach hereto one of these documents which has been in hand for some three years. It represents a transaction in bar iron. You will note the railroad has endorsed the document "shipper's load and count more or less," which gives the Australian consignee no redress against the steamer for shortage; also that the combined bill gives absolutely no guarantee as to how or when the goods will be shipped from your seaboard, so that it may be months after a portion of the invoice has been delivered before the shipment is complete.

Neither Negotiable nor Legal

From a banker's point of view, according to a leading Australian member of this class, the objection to the document is that it is not legal security. The courts throughout the British Empire rule that a bill of lading is a valid instrument only when the goods are actually shipped. A bill of lading which does not show the name of the steamer is not a valid instrument and therefore not a legal security. A banker negotiating a draft supported by such a document has no tangible security; he runs the risk of the drawee's declining to pay until the arrival in Australia of the goods. No remedy is in the hands of the banker for goods shipped short; while experience to date has shown that in connection with the combined rail and steamer bill, irregularity of shipment is almost chronic. Some remedy for this state of affairs may be found between the shipper and the American bank; but it should be a *sine qua non* that the draft must be retained by the negotiating bank in Canada or the United States until actual date of shipment and identity of steamer are assured.

At the beginning of 1916 I had 700 tons of steel shipped from Pittsburgh to Australia via the Pacific coast on a combined bill of lading. The goods were paid for in Pittsburgh under a confirmed banker's draft as soon as the bills of lading were signed, and in all probability before the material reached the seaboard. The bills of lading duly arrived here attached to the draft. They were endorsed "shipper's load and count." It took six months for the material to reach the Australian consignees in an uncomplete state, and 12 months from the date of draft before final settlement was arranged here. The steamship company was not responsible for quantities. The railroad that carried the goods from Pittsburgh was not responsible because of the endorsement on the draft. I had to stand out of my money (some thousandsof pounds sterling) for 10 months.

If an ocean bill of lading, the only document we know on this market as a valid bill of lading, had been issued by the steamship company when it received the goods, the manufacturer could only have been paid—by the negotiating bank—for the actual quantity of goods put aboard the boat and acknowledged by that bill; and these they would have to deliver or pay a claim.

I have another case, shipper's copy of combined bill attached. On June 29th, 1918, three cases of hair ornaments were shipped from Quebec to Melbourne on through bill. The manufacturer was not versed in export business, so the shipment was handled by an export association, which negotiated the draft under a confirmed banker's credit early in July. The draft was paid here in Melbourne at the beginning of August, and in February, 1919, there is no sign of the goods. The steamship company disclaims responsibility; they have no knowledge of the material, as the bill is signed by a railroad company "without responsibility." No name of steamer is mentioned; the bill is worded "the goods may be shipped by the steamer ——— or any other steamer of the same line." Surely this is sufficiently elastic to outlaw any possible claim that might be made. At any rate I have found it so; I have been standing out of this 400 pounds at six per cent since August. I can get no satisfaction out of the steamship company, and no satisfaction out of the works; and if you in your own country cannot collect claims from your Government-run railroads, what chance does a claimant in Australia stand? If an ocean bill of lading had been issued on these goods I could have claimed on the steamship company here in Melbourne, and if the goods were not delivered within one month the company would have had to pay the value plus 10 per cent.

The ship company's attitude toward the combined bill is well shown by a quotation from their letter refusing to stand responsible. "As you are aware," they say, "shippers use the combined bill of lading to save them trouble at the ocean port of shipment. They, of course, could obtain a purely ocean bill of lading by forwarding the goods to, say, Vancouver, and arranging shipment themselves on a fresh bill of lading." They might have added that they could see no reason why they should pay for the shipper's laxity; doubtless there is none. But there is no reason why I should pay for it either, yet I am doing so.

Space does not permit my writing fully of the buyer's point of view toward this villainous document; but I assure you that when I try to book a repeat order for the company that furnished these combs, I shall get a very poor reception. So perhaps that company, and others like them, may eventually learn that it does not pay to do things in the cheap and nasty style.

I understand from your article and other sources that the through bill will probably be eliminated or improved. I do not believe it can be improved in such a way as to make it acceptable to the foreign buyer. In any event, whatever its fate, I think the whole matter is an admittable text on how not to conduct foreign trade.

HUGH SCOTT-YOUNG.

Melbourne, Australia.

Foreign Trade from the Receiving End

To the Editor of the SCIENTIFIC AMERICAN:

I RECEIVED your very full reply to my request for information relative to American manufacturers of certain products. To each of the firms which you mentioned I wrote, asking for full particulars with reference to the possible availability of their goods for my use. Instead of forwarding literature descriptive of the articles in question, or otherwise attempting to give full particulars that would afford me a basis for intelligent consideration and decision, they answered [illegible] by themselves asking questions, as though I were sitting around the corner and could telephone my answer or send it around by the office boy—I, who am situated on the other side of the pond, thousands of miles away. I expected to receive information that would put me in position to go ahead and act; the possibilities were not so complicated but that a well edited catalog would have amply filled the bill. But I have to ask again and wait perhaps several months to get it.

I have been in Brazil for many years, and being an American citizen, it is but natural that I should try to patronize American manufacturers first. But if they care at all for the Brazilian trade—which we flatter ourselves is not small—they must adopt a different procedure. They must send literature stating fully and clearly: this is what we can do; leaving it to the parties here to find out then whether the article, price and conditions suit or not. And you may be sure that the Brazilian will find out and decide quickly! That way would save time; but writing letters and letters, answering the questions of manufacturers who want to find out whether their article will fill your wants before they will tell you anything about it, when done over a distance of 5,000 miles cannot lead to results.

Another thing: why had I to call on you, a disinterested third party, for preliminary information in the first place? Because I could not obtain it here on the spot. There exists no proper place in Rio where I could go for it. Formerly there was a waiting room at the American consulate where one could at least go and hope to get such questions answered, consult directories and catalogs, etc. If it was not entirely satisfactory it was better than nothing; it was at least a place where Americans passing a short time in Rio could meet and exchange ideas, and where permanent residents here could get some kind of contact with America and her industries. It was duly appreciated by many. Before writing you, I went there and found the place converted into a sort of police court, with a couple of policemen smoking cigarettes—a change not exactly for the better. What is wanted is a "Bureau de Renseignments" such as other nations established long ago—a place well provided with ample literature covering American industrial production in all its ramifications and details.

How Not to Cater to the Retailer

The backbone of Brazilian trade—of any trade in fact—is represented by the retail dealers. It is they who must dispose of the goods, who are in direct contact with the consumers, who put on the market the products which the genius, brains and capital of the manufacturer have created. They form the first line of battle in that great struggle for industrial and commercial supremacy which is now raging over the whole world. They constitute therefore a class deserving of special care and attention.

Some days ago I heard a merchant of good standing in Rio complain of the careless manner in which a rather considerable order of his had been filled by the American exporter. It is known that the stores of these merchants are as a rule limited in space, and that it is by no means convenient for them to handle all at once a good sized shipment. It is necessary for them to store such a shipment in some other place and use it as a source of supply on which to draw for the replenishment of their stock, according to necessity, by opening the case containing the particular article just wanted in the store. I should think that this state of affairs would be sufficiently universal to be almost an A-B-C of merchandising. Yet the merchant alluded to, when he attempted to put certain items from his shipment in immediate stock, and when for that purpose he looked over the papers relative to the shipment, hoping to find a list specifying the contents of each packing case, found that nothing of this sort had been furnished; and to get at the article for which he had immediate and urgent need he had to open more than fifty cases. No exporter who cares for his customer omits to send such a list with the invoices; it forms an essential part of the shipping documents.

If these remarks are printed, the reader will perhaps say: We know all about that already. Why, then, don't you do it, if you wish to do business here? It would certainly advance American interests a great deal more than the sending over of Commissions composed of millionaires or the sons of millionaires, who stare at things and at people as though they were in a curiosity shop, have a spin around the city and to Petropolis, banquet in the evening, and after the customary official and unofficial speechifying vanish to other shores and climates without having done anything of practical value.

C. DE STRUVE.

Petropolis, Brazil.

A Coal Container That Is Thief-Proof

WITH coal ever soaring in price, here is an adaptation of a thief-proof container in the steel coal pocket. It has a capacity of 750 tons, divided into six bins. An electric hoist levates the coal at the rate of one ton per minute, or one car in less than an hour. At the top a movable spout directs the coal to the bin desired. The pocket rests on a concrete foundation and the outlet gates load by gravity into delivery trucks. One man can care for the pocket in both filling and unloading.

The Detection of Over-Heated Bearings

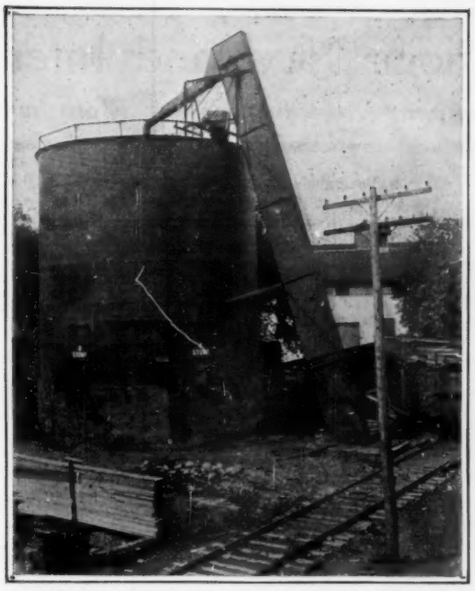
THE most recent improvements in the use of substances that show overheating of bearings by color changes have been made by Pinnock. A mixture of 85 per cent of copper mercuric iodide, Cu_2I_2. 2 HgI_2, with 15 per cent of silver mercuric iodide is very sensitive to heat and gives a very sharp transition from vermillion to almost black at 60 degrees to 70 degrees C. To apply to bearings the material is mixed with white shellac spirit varnish in the proportion of 100 parts of the color compound to 70 parts of the varnish. After painting as a spot or band on a background of zinc white it is given a protective coating of a colorless oilproof varnish.

Vegetarian Beef Extract

IN the manufacture of ethyl or grain alcohol, yeasts are used to convert starches or sugars into alcohol. There is always a great excess of the yeast, so well does it thrive, and after every vat fermentation there is a great quantity to throw out.

This waste should be saved for it is rich in protein. For cattle feed the yeast needs only washing and drying. Even as a fertilizer it is of high value for it is rich in nitrogen, potash and phosphorus, the three essential elements of a complete fertilizer.

But as a human food this yeast has infinite possibilities. In fact, it has reached an important industrial stage already in England. If yeast is washed free from wort and mash and left in pure water it no longer grows, as there is no food for it, but digests itself. The enzyme, endo-tryptase, breaks down the complex protein molecule into simpler compounds—albumoses, peptones, amido acids and ammonia in consecutive order. If the process is stopped by sterilizing at 70 degrees C. to destroy the enzymes at a point at which peptones and amido acids predominate, the product becomes a splendid food containing as much as 35 per cent of peptones and amido acids. When well-made it has the same taste as beef extract and is easily digested. The sale as "vegetable extract" has become large in England.



The thief-proof coal-pocket with loading and unloading chute

A Rowboat That Packs Into a Small Hand Bundle

THERE has been almost no end to the small portable boats, which can be carried about in collapsed form. However, it is doubtful if any one of these already introduced offers the convenience of that shown in the accompanying illustration, which is the invention of Mr. Swinburne of Southfields, England.

The craft of this English inventor packs away into a small bundle measuring some two feet long by one foot wide. The package can be carried in the hand or under the arm. The rowboat, in this instance, consists of an oblong arrangement containing four compartments, which are easily and quickly pumped full of air by means of a simple bellows arrangement comprising part of the equipment. The oblong structure holds the fabric floor of the craft. The accompanying illustrations, showing the unique boat being carried and in use, virtually speak for themselves.

Facilitating Women's Work in Paris Railroad Shops

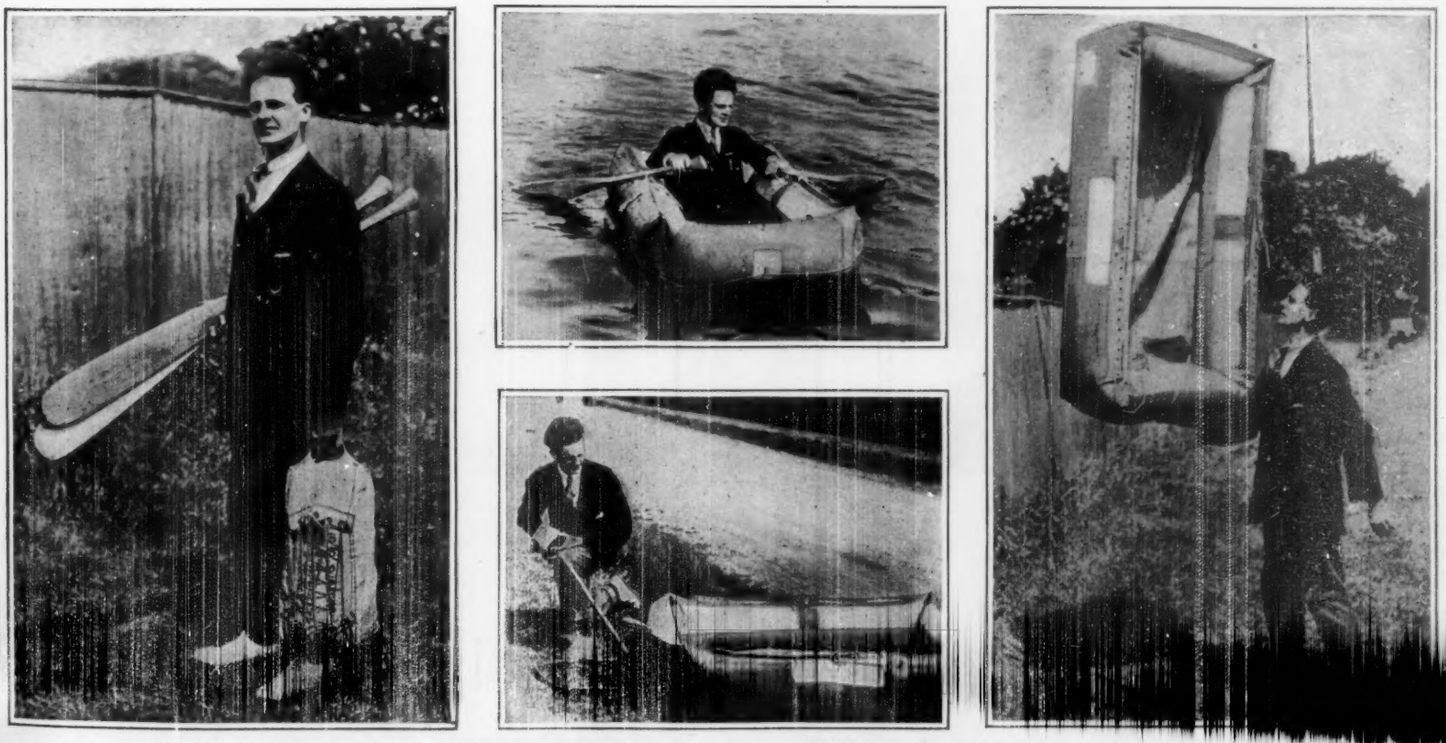
IN order to facilitate women's work in the repairing shops of the Orleans Railway Company at Paris, where, as in Great Britain, feminine labor is becoming more and more in demand, a very practical portable oxy-acetylene welding apparatus has recently been introduced. It consists of the usual cylinder of oxygen, filled under a pressure of 10 kilos, and the acetylene reservoir, these being mounted on a two-wheeled wagon which can be easily moved from place to place even by a mere girl. India rubber tubes several yards long connect the gases with the blowpipe, which is provided with the customary safety arrangement. In addition, the welder has within easy reach a stop-cock, enabling her to regulate the flow of the oxygen and acetylene before they reach the mixing chamber of the blowpipe. It has been found that, thanks to this handy apparatus, a woman worker is able to do a multitude of small soldering jobs with great rapidity and, what is equally important, with a minimum of fatigue. The apparatus is perfectly safe, and the operators find no difficulty in using it.

Why There Is a Limit to Forests

THAT all lands in the United States better suited for growing trees than for growing anything else should be used for growing trees has been a doctrine long preached and generally accepted without question. But Dr. Wilson Compton, Secretary-Manager of the National Lumber Manufacturers' Association, says this is not only not *necessarily* but it is not even *probably* true.

To explain his assertion he gives the extreme illustration that if 95 per cent of the land of this country were better suited for pasture land than for any other purpose, would we use 95 per cent for this purpose and become a pastoral people? Or, if 60 per cent of the area of the country were better suited for growing trees than for agricultural crops or grazing, would this country use the 60 per cent for tree growing and "thus have lumber enough to house five times the number of people it could feed?" In the state of Maine, Dr. Compton points out, much of the land is best adapted for forest growing, but to feed its people is quite as important as to house them and it is wiser economy to devote part of the land to raising mediocre agricultural crops than to devote all of it to raising splendid forests.

Dr. Compton looks at the question in a big way and from the viewpoint of the Nation's needs, and he concludes that the "clearing of the land has frequently paved the way for industrial and agricultural expansion which has produced greater wealth than did the forest industries in their prime."



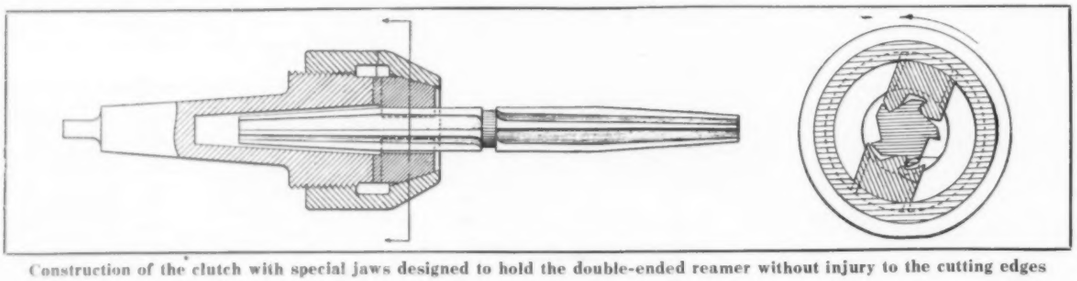
Weighing but a few pounds and packing into a small bundle, this unique rowboat is always available for the camper and the traveller

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

A Reversible Reamer

A PLAN to make a reamer do double duty has been worked out by R. A. Caird, of Pittsburgh, Pa. His plan is simply to convert the shank of the reamer into another reamer, which makes a double-ended tool. Of course a special chuck is required to grip the reamer without injury to the cutting edges. The design of the chuck is shown in the sectional views and attention is called particularly to the form of the jaws, which have lugs that fit into the grooves between the teeth of the reamer. The lugs are offset so as not to touch or mar the cutting edges. The tool is held rigidly close to the neck which divides the reamer in two. The design of the chuck is such as not to damage any part of the reamer even when it is reversed. The staggered features of the chuck jaws practically remove all danger of breakage, and the tool is not liable to work loose. It is claimed for this tool that there is a saving of almost a pound of steel because the reamer does away with the shank and there is a saving in cost of from thirty to fifty per cent over two regular one-piece reamers. The tool is adapted to bridge, boiler, ship-building and structural-steel work, in which the service is severe. The reamer is shown both in the accompanying line drawings and the photograph.



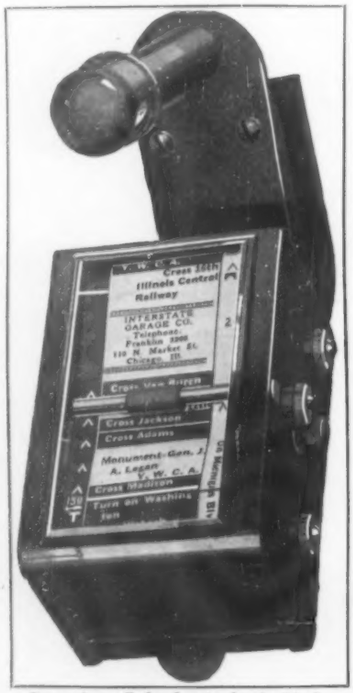
Construction of the clutch with special jaws designed to hold the double-ended reamer without injury to the cutting edges

A double ended reamer adapted to the double service, and operating on the principle depicted in the above drawings

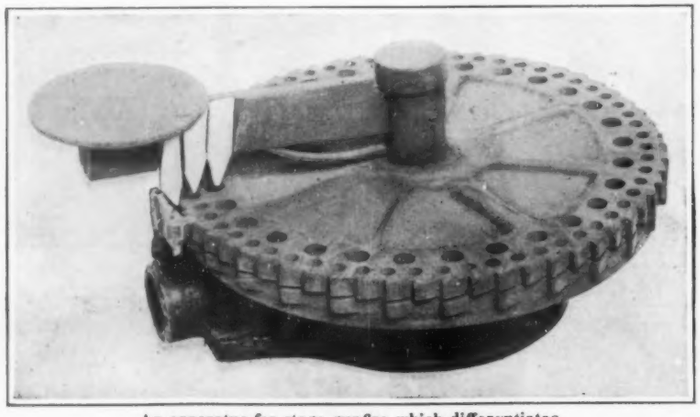
Gun Which Shoots Sounds Only

PERHAPS the strangest gun ever conceived and the only one of its type ever manufactured is the one shown herewith for enabling the sound of rapid gunfire to be reproduced on the stage. Although capable of firing cartridges of two different sizes, singly, simultaneously or in volleys, it is quite harmless. It is an orchestra gun and the invention of a bandmaster. It shoots blank cartridges.

The orchestra gun is worked with the foot. It has chambers for thirty .32 caliber cartridges or sixty .22 caliber cartridges in the revolving disk. By firing a .22 and a .32 simultaneously, the effect of a .41 is obtained. The reports issue from an opening below the disk.



Operating off the front wheel, this instrument gives the motorist all necessary information at all times



An apparatus for stage gunfire which differentiates between the reports of different calibers

An Automatic Guide for the Motorist

INVENTIVE genius has found an automatic substitute for the road guides, route books, logs, and maps that motorists commonly use on long tours. This substitute is nothing more than a tape carrying full instructions and information as to the route and the points of interest, which is mounted in a suitable device that attaches to the instrument board or dash of any automobile and is conneced with the front wheel. As the car starts away on a trip, the tape in the automatic road guide begins to unwind itself under a glass on the face of the instrument. Directions on the tape indicate the car's exact position anywhere on the road and give warning miles ahead of all turns, bridges, railway crossings, or danger spots. Everything that the man in the car needs to know about any route he has never travelled before, including hotel and garage accommodations, historic points of interest, and other information, is brought before his eyes without his having to lift his hand from the steering wheel at any time.

The automatic road guide is simplicity itself. Being small and compact in size, it works with accuracy. Indeed, eminent automobile engineers have marveled at its operation. For night travelling over dangerous roads, it is almost indispensable to motorists. The organization which is introducing this new instrument has gone to the expense of logging and recording on tapes thousands of miles of roads in the East and Middle West, covering all principal points west of New York City. Tapes begin and end at service stations in each city, and these stations keep tapes for various routes always on hand for free distribution to the users of the automatic road guide. For instance, it is possible for a motorist starting on a tour, to pick up a tape that will direct him from New York City to Albany, and upon reaching Albany he can exchange his tape at the service station for a route to Syracuse, Buffalo, or any other city he wishes to reach. While this idea is not altogether new, its commercialization is certainly something quite novel and ingenious.

The Current Supplement

AT this season of the year the farmer and the agriculturist generally begin to experience their first worry about the approaching season of harvest and its accompanying early frosts. The U. S. Department of Agriculture has long had in preparation a very instructive atlas mapping the dates, frequencies, and distribution of frost in the United States and the interesting general article, *Frost in the United States*, illustrated by maps and text in the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2277, for August 23, 1919, gives the general results of the survey, as well as describing the great practical value of the individual government maps. Unfortunately for the United States this same season brings an annual loss, in our national wealth, of many millions of dollars worth of forests destroyed by fire. Sad as is the sight of a great forest fire it sometimes offers a specious return to us in the form of magnificent columns of smoke surmounted by very interesting resultant cloud forms. Our cover illustration presents such a phenomenon, and certain of the attendant meteorological features are discussed in *Clouds Induced by Forest Fires*.

In somewhat lighter vein is an interesting illustrated article which shows how very ancient is the true *Origin of American Agriculture*, and how nearly present types of Maize and Squash, for example, resemble those we know to have been raised and eaten by prehistoric inhabitants of the Americas. A particularly timely illustration is a large drawing illustrating the similarity and dissimilarity in products and applications of products derived from *Oil and Coal*, with an excellent discussion of the ways in which the one may prove able to supplement or replace the other. German experiments devised to reveal the indispensable elements in human diet, particularly of the food Butter, are discussed in the article, *Specific Nutritive Values*. The series *Experimental Wireless Telegraphy and Telephony* is represented by its fourth installment, and a long paper on *Illuminating Devices Used in the Great War* appears in its first installment.

The always important subject of *Effect of Fog on Light Intensity* particularly from the standpoint of fog effect on different colored lights is the subject of a careful research reported under that caption. Workers with ultra-violet light whether for projecting or for microscopic work will be interested in a device for *Separating Visible from Invisible Light*. Shorter articles deal with a *New Case-Hardening Process*, *Cyanimides Substituted for Cyanides*.

Accuracy

EFFORT is fruitless without accomplishment: accomplishment is the product—the sum total—of a demonstrable plan ACCURATELY executed to finality. SEEMING completeness is not enough. An unseen fault, an unintentional omission, an unconscious neglect, a hidden weakness, an imperfect interpretation almost invariably result from some trifling or calamitous inaccuracy.

An ACCURATE plan and a clear, clean, instantly interpretable blue print (every dot, line and figure vividly distinct) are the parents of every enduring structure either small or great.

The Wickes Blue Print System is always accurate and true. It prints sharp, clear and distinct, free from blotches and faded lines which assures a true blue print.

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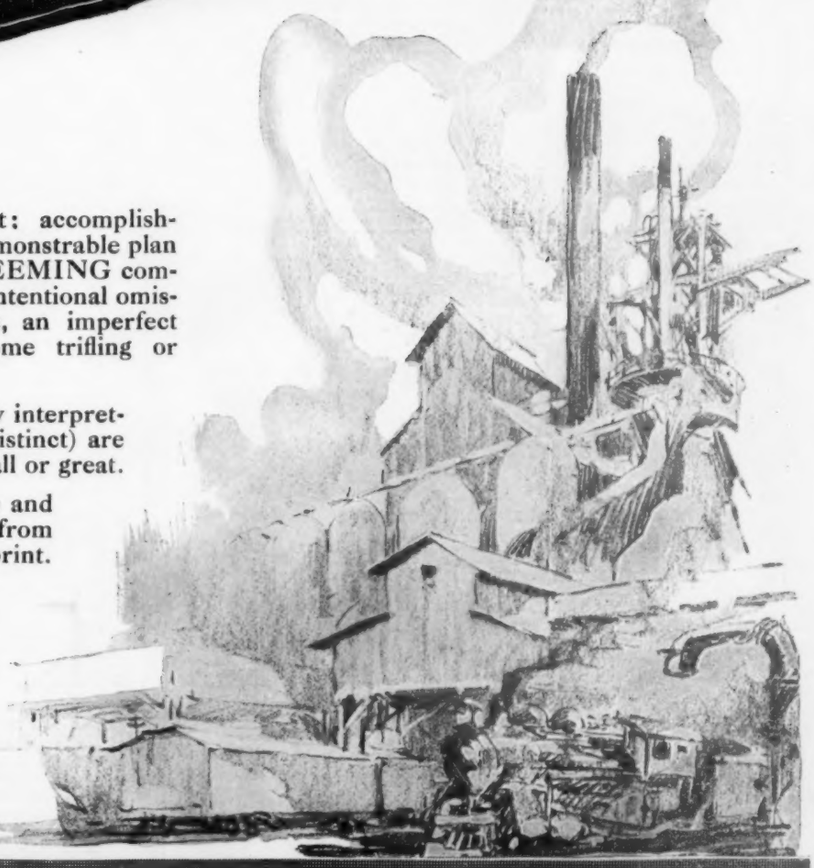

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We dislike to use superlatives in describing our product; we prefer to put the superlative into the work. We *must*, to maintain a reputation that has, for nearly half a century, stood for "Superior" Drop Forgings. And that reputation stands solidly back of our "Vulcan" Safety Lathe Dogs.

Bent and Straight Tail patterns, 16 sizes, 3/8" to 6" capacities. Also made with two screws for extra heavy service.

Write for Machinists' Tools Booklet.

J. H. WILLIAMS & CO.
"The Drop-Forging People"

Western Office and Warehouse:
28 So. Clinton Street
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General Offices:
28 Richards Street
Brooklyn, N. Y.

Our Technical Achievements in the Great War

(Continued from page 189)

markable feature of this construction work was its rapidity. Each cantonment was built in substantially 90 days, and it was this speed that made it possible to get the draft army under training before the winter of 1917 set in, and therefore made it available for the critical battles of the summer of 1918.

Construction Work in France for the American Army

The construction program in France matched, in its magnitude and the number of projects, that which was being carried on in the United States. If there was less building for shelter and for munition work, there was more for the development of port and railways facilities, and for the repair and operation of army equipment. Storage space built in France was over nine-tenths the amount at home; and the French hospitals capacity was double that at home.

It should be noted that all construction in France was done by the Corps of Engineers under the Services of Supply. The labor force consisted large of American soldiers and German prisoners, although French and English civilians and Chinese coolies were used wherever available. Up to the signing of the armistice 831 construction projects had been undertaken by the Corps of Engineers and their distribution over France is shown on the accompanying map.

Food and Clothing at the Front

It will be understood that the real test of the efficiency of the supply service comes when an army is engaged in battle. Measured by this test, the work of feeding, clothing and equipping the American Army was well done; for we are told that in the main the Expeditionary Forces received what they needed.

Food and clothing are of course the most essential supply and at no time was there shortage of food for our men. Of course sometimes soldiers went hungry in this, as they have done in other wars, but this happened only occasionally and the condition was local and temporary. It occurred because of transportation difficulties during periods of active fighting or rapid movement, when the units outran their rolling kitchens.

As to the matter of clothing the Supply Service rose to the emergency of combat. The Quartermasters' records show that during the six months of hard fighting from June to November, the enlisted men in our forces received on the average:

Slicker and overcoat, every five months.
Blanket, flannel shirt and breeches, every two months.
Coat, every 79 days.
Shoes and puttees, every 51 days.
Drawers and undershirt, every 34 days.
Woolen socks, every 23 days.

During the winter and spring of 1918, the amounts on hand rose steadily. On May 1, about the time when American troops were entering active fighting for the first time, there was well over a forty-five day supply on hand, which was considered the required reserve during the latter month of the war.

Acetylene Motors

EVEN before the war various attempts were made to employ acetylene to run automobile motors. As long as gasoline was plentiful, however, the difficulties in the way of using acetylene seemed discouragingly formidable. During the war, however, more determined attempts were made to solve this problem. *Le Journal de l'Acetylene* has just published a report by an engineer named Keel, describing the results obtained by various Swiss experimenters; no less than eight important firms experimented with acetylene motors and the Swiss army likewise made a study of the question. The acetylene employed may be of two kinds: acetylene dissolved

(Continued on page 196)

LEGAL NOTICES

PATENTS

IF YOU HAVE AN INVENTION which you wish to patent you can write fully and freely to Munn & Co. for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention and a description of the device, explaining its operation.

All communications are strictly confidential. Our vast practice, extending over a period of seventy years, enables us in many cases to advise in regard to patentability without any expense to the client. Our Hand-Book on Patents is sent free on request. This explains our methods, terms, etc., in regard to **Patents, Trade Marks, Foreign Patents, etc.**

SCIENTIFIC AMERICAN
contains Patent Office Notes. Decisions of interest to inventors—and particulars of recently patented inventions.

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AN establishment devoted chiefly to the improvement of wooden wind band and orchestra instruments, but overlooking none of the kindred arts. Drummondville, Province of Quebec, Canada.

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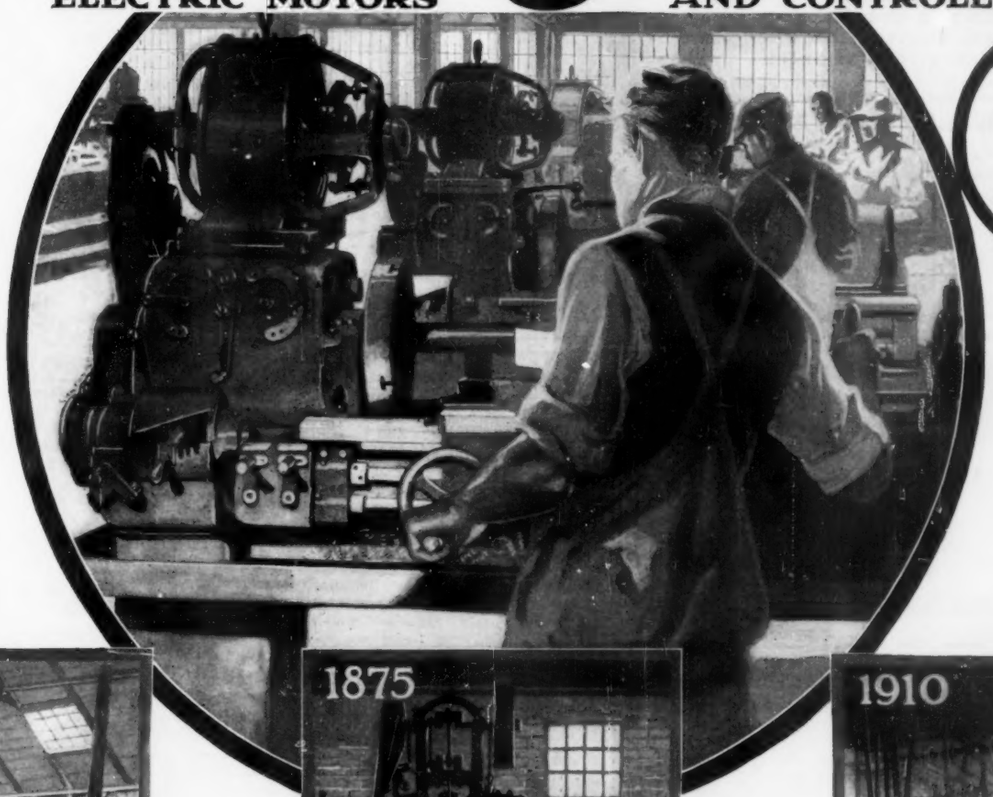

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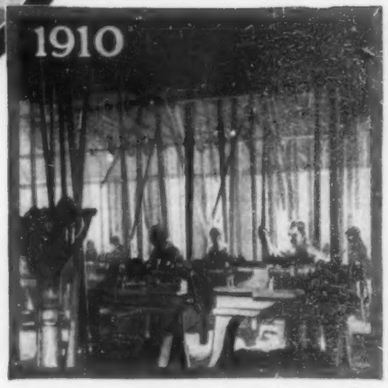
WESTINGHOUSE ELECTRIC



How Long is a Plant Up to Date?

Those who have watched the progress of industry know well that the *up-to-date* in tools, machinery and methods is soon *out of date.*

Few stop to consider that their electric drive installed ten, or perhaps only five, years ago may now be far behind the times.

Yet such is the fact, because even in that short space methods have been developed for reducing power loss, inefficient routing of work, spoilage, delay and many other causes of waste, which all result in higher costs and lessened production.

Your own plant may need more individual motors or motors of a slightly different type.

Changed manufacturing conditions may necessitate rearrangement of group drive, a replacing of motors and machines. Requirements may be such that an investment in new motors would result in a considerable increase in output and improvement of working conditions.

Why not get the facts?

Just such problems as may exist today in your plant are being solved every day by Westinghouse engineers.

The experience of these men, skilled in practically every industry, is freely at your disposal both in recommending the kind of drive and type of motor needed and in selecting the Westinghouse Motor that exactly meets the requirements of each particular task.

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Whether you are cutting by power or by hand, big quantities of a comparatively few kinds and shapes of metal, or smaller quantities of a lot of different sorts, there's a blade in the Starrett line that was designed to meet your need.

Write for the Starrett Hack Saw Chart B" and see what blades cut different metals cheapest.

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Quantity production of a high class machine tool has made possible the low price of MONARCH Lathes.

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BRODERICK & BASCOM ROPE CO.,
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Manufacturers of Celebrated Yellow Strand Wire Rope—For all Marine Purposes

Acetylene Motors

(Continued from page 194)

in acetone or the acetylene produced directly from calcium carbide. The dissolved acetylene has the advantage of being pure and of being kept at a suitable pressure; on the other hand it requires the use of containers of considerable weight—15 kilograms of dead weight per cubic meter of gas. The acetylene produced directly must always be carefully purified and filtered. Among the advantages exhibited by these motors are their silent functioning, the ease with which they are started, and the cleanliness of the service.

One 30 horse-power motor (4 cylinders) making 100 revolutions, consumes 260 liters of acetylene per horse-power and per hour. The average requirement is 1 kg. of carbide per horse-power and per hour. A 700 kg. automobile travelled 35 km. with 7 kg. of carbide without the injection of water. In short one kilogram of carbide is equal to 0.66 liters of gasoline (benzine).

Legitimization of Soya Bean Oil

By Henry A. Gardner

THE rapidly growing production of soya bean oil in the United States is to a very great estent due to the early work of the Educational Bureau. During the past year there has been produced in North America over five million gallons of this oil, and an additional large quantity has been imported.

Exposure tests have shown that 20 per cent of soya bean oil may be mixed with 80 per cent of raw linseed oil to produce a paint liquid that will wear quite as well as pure linseed oil. The above mixture will show an iodine number (index of drying value) of approximately 170 when North American linseed oil is used as the base. In the writer's opinion, the above mixture (with an iodine value not less than 170) may be used with successful results in high grade paints. The adoption of this mixture for at least many types of paint in which it is customary to use linseed oil wholly, would be suggested. There should be no hesitation in disclosing, where analsis labels are now used, the actual composition of this liquid, as it is a thoroughly legitimate product which has proved satisfactory in scientific and practical tests.

Soya bean oil mixtures are excellent for the grinding of certain paste tinting colors. The raw oil is of lighter color than raw linseed oil, and may be made even lighter by refining. Soya oil grinds easily with pigments and produces pastes that remain soft and less liable to stiffening in the package than those made with pure linseed oil. The amount of soya oil introduced into a house paint, for instance, through the use of painter's paste tinting colors made on the above basis would be extremely small and would not have any substantial influence upon the drying of the paint. Because of the above properties of soya oil, it would appear that it is an oil that is even more desirable than straight linseed oil for color grinding, and that colors produced with this oil should really have a higher sales value than those ground wholly in raw linseed oil.

Soya oil requires a higher percentage of drier than linseed oil. Cobalt driers have been found very satisfactory and even more efficient than lead or manganese driers. Cobalt linoleate is probably the most desirable, since it has a high degree of solubility in the oil and may be brought into solution at comparatively low temperatures. Cobalt acetate has sometimes been used in soya oil by the varnish maker, being introduced at high temperatures. The development of acetic acid vapors by this process sometimes results.

Soya oil has a higher flash point than any other vegetable oil used in the paint industry. It may be heat treated and blown to a viscous form. Its value in varnish making has already been indicated, and it is probable that it will soon be established firmly in the industry. Its further use is suggested.

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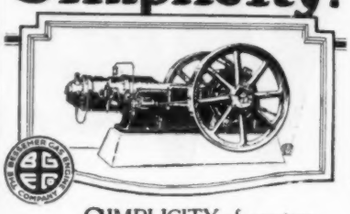

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